Best Management Practices

For Community Trees in Terrebonne Parish Louisiana

October 2007

Prepared by

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Terrebonne Tree Board

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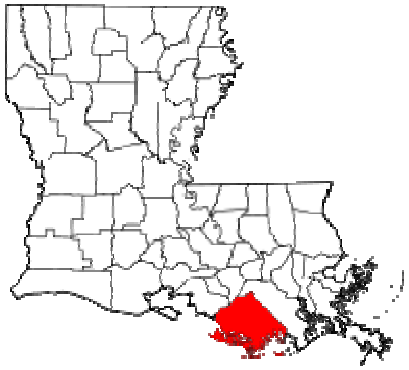
Introduction



Paroisse de Terrebonne or Terrebonne Parish was formed in 1822 from a portion of adjoining Lafourche Parish. Terrebonne means "good earth" in French and comprises 14.2 square miles of land and .1 square mile of water with an overall population density of 83 persons per square mile. The parish residents enjoy a rich cultural heritage with over 10% of the population still considered to speak French.

According to the 2000 census, Terrebonne Parish recorded a total population of 104,503 people. Houma is the parish seat with a 2000 population of 32,393 people with a density of 2,308.5 persons per square mile.[i] After absorbing the powers of the City of Houma, the parish has operated as one of the few consolidated governments in the state of Louisiana.

Adjacent to Houma is the town of Cane Bayou with a population of 17,046. Although this area is a census designated town, it is commonly referred to as Houma which would place the population of the greater Houma area at approximately 50,000 inhabitants or almost one half of the total parish population. The parish also includes 6 other incorporated communities including the towns of Bourg (pop. 2,160), Chauvin (pop. 3,229), Dulac (pop. 2,458), Gray (pop 4,958), Montegut (pop. 1,803) and Schriever (pop. 5,880) and the unincorporated areas of Ashland, Cocodrie, Donner, Gibson, Point Aux Chenes and Theriot.

[i] Wikipedia, *List of Louisiana parishes by French-speaking population*. Retrieved June 1, 2007 from http://en.wikipedia.org/wiki/List_of_Louisiana_parishes_by_French-speaking_population.

How Trees Grow

A tree is defined as a long lived, perennial woody plant that grows 15 feet or more in height, usually having secondary branches supported on a single main trunk, growing to more than 2 inches in diameter at maturity.

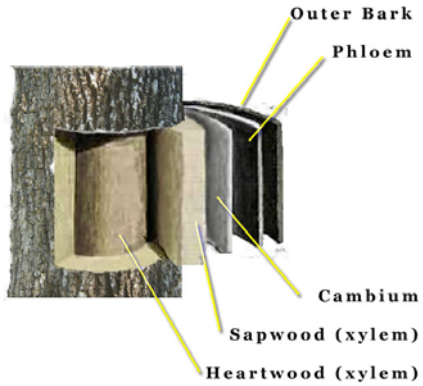
Trees grow by producing new cells in a very limited number of places. Trees grow in height as a result of buds formed at the tip of their branches. New growth is added at the tips. This is why a nail driven into a tree trunk never changes in height.

Roots expand through the soil by growing at their tips. As the twigs and roots elongate, they also increase in diameter. Trunk, branches and roots continue to increase in diameter as a result of growth that occurs with new cells being formed in the vascular cambium. The trunk connects the leafy crown with the roots. Diameter growth continues as long as the leaves are on the tree.

Roots absorb nutrients and water from the soil and transport them up the trunk in cells that act much like pipes. This allows leaves to obtain water and nutrients necessary for the manufacture of food from light energy or photosynthesis. Food made in the leaves is transported down to the roots and other parts of the tree for growth.

Bark is the outer covering of dead tissue, which protects the

How Trees Grow



tree from weather, disease, insects, fire and mechanical injury. The layer inside of the bark is called the phloem and is responsible for transporting food around the tree. The next layer is the vascular cambium. This very thin layer produces phloem to its outside and the largest portion of the trunk known as xylem to its inside. The xylem is composed of dead thick cells that act as pipes for transporting water and nutrients up the tree. The active portion of the xylem is known as the sapwood and is found near the outside of the tree. Older xylem is heartwood and is darker in color and less active in the transport of water and nutrients. An annual ring is one year's worth of xylem growth. Xylem cells formed in the spring are larger than those formed later in the summer.

When conditions becomes unfavorable for growth, i.e., dry or cold, elongation slows and a new bud starts to form. Some buds remain dormant through the growing season and get buried in the bark as is the case in oaks. When a branch is broken or cut off an oak tree or the tree gets cut down, the oak sprouts right back from these dormant buds.

Soil is composed of weathered rock or clay or parent material and mixed with dead or decaying leaves, twigs and organisms known as organic matter. Organic matter and soil provide needed nutrients to support a root system for a tree to grow.

photosynthesis

CO_2(carbon dioxide) + H_20 (water)
= $C_6H_{12}O_6$ (sugar) + O_2(oxygen)

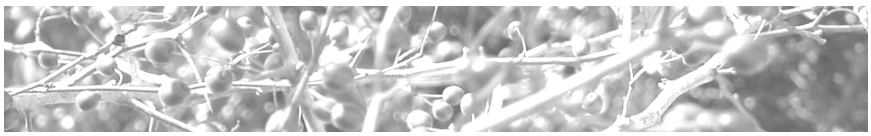
How Trees Grow

Trees cannot replace damaged or destroyed cells in the same location. As a result, root, trunk or crown damage can have an adverse effect on the tree for the remainder of its life. Trees never heal wounds, but rather seal off or compartmentalize the affected area. Arboricultural practices can be effective in increasing the chances of a tree compartmentalizing some wounds, but simply applying tree wound dressing is not of significant value. Such wound dressing can mask odors emitted by wounds which attract insects and is vital in protecting oak trees against oak wilt fungus.

Trees store energy that they use to withstand unfavorable conditions such as attacks by insects and other organisms, injury or stresses caused by adverse construction activities, or unfavorable weather conditions.

Tree roots provide three primary functions: 1) support, 2) intake of nutrients and water, and 3) storage of food reserves. Cutting or damaging tree roots can adversely affect these essential functions.

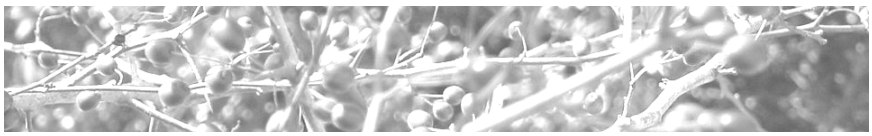
Tree roots require oxygen to respire in order to survive. Conditions such as excessive fill and/or soil compaction or ponding of water can adversely affect essential gas exchange resulting in the accumulation of carbon dioxide in the soil and other toxic



gasses which can adversely affect tree roots.

Trees establish a balance between root and crown. Destroying a portion of one may lead to the destruction of the other affecting the health and vigor of the tree.

Approximately 99% of the tree's roots occur within the first three feet of soil with most of the fine feeder roots located in the first four inches and can extend as much as two to three times the distance to the dripline.



Benefits of Trees

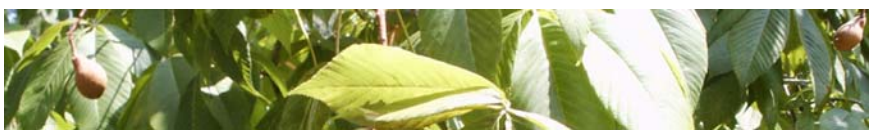
Although most trees and shrubs are planted in our communities to provide shade or beautify an area, these woody plants provide additional social, public, environmental and economic benefits far beyond aesthetics. These community trees are an integral part of Terrebonne Parish's infrastructure and perform essential functions that benefit our community and our environment.

Social Benefits

Hospital patients have been shown to recover more quickly from surgery when their hospital room offered a view of trees. According to the 1993 study, The Role of Nature in the Workplace, by R. Kaplan, desk workers without a view of nature reported as much as 23 percent more ailments than their counterparts in six months of study. Workers with views of trees are generally less frustrated, more patient and exhibit higher overall job satisfaction and enthusiasm with less stress and lower systolic blood pressure.

Public Benefits

Considerable space is needed for large trees that are a benefit to more than the property on which they are planted. Even though trees are planted on private property, their size makes them an integral part of the community. For this reason, careful thought should be given to the proper selection and maintenance to enhance the benefits without infringing on the rights



Benefits of Trees

Environmental Benefits

The leaves of a mature tree intercept an average of 760 gallons of rainfall each year.

and privileges of neighbors.

Trees planted on public property including rights of way, parks and greenspace can provide both functional and aesthetic benefits by directing views and pedestrian traffic, reducing glare, providing needed shade, and soften, complement and enhance architecture.

Trees improve air quality, provide wildlife habitat and conserve water and reduce storm runoff and lessen flooding. In south Louisiana where hot summers are routine, trees can provide needed shade to moderate heat-island effects often found in paved, urban and suburban areas. Tree leaves filter the air by removing dust and other particles, absorb carbon dioxide, ozone, carbon monoxide and sulfur dioxide and give off oxygen. The leaves of a mature tree intercept an average of 760 gallons of rainfall each year. Trees absorb large quantities of water and evaporate it slowly back into the atmosphere.

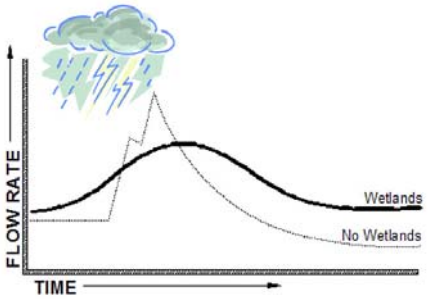
The Climate Trust estimates an average sized, single family household with two mid sized autos produces in excess of 18.6 tons of carbon dioxide each year.[i] The average yard tree cleans 330 pounds of carbon dioxide from the atmosphere each year. Trees can absorb and store on the average 13 pounds of carbon each year valued at $22 per year based on the estimated value

" [i] *Become Carbon Neutral Today*", Retrieved June 1, 2007, from http://www.carboncounter.org/offset-your-emissions/personal-calculator.aspx

of carbon removal at $1.70 per pound.

The positive environmental affects of the urban forest cannot be minimized.

Trees and Wetlands



It is estimated that Hurricane Andrew storm surge was reduced about three inches for every mile of marsh.

Wetlands are defined as "those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (40 CFR 230.3) Both coastal wetlands and inland wetlands play an important role in flood protection, water quality, and critical habitat for a diverse number of animal and bird species in south Louisiana. Barrier islands, shoals, marshes, forested wetlands and other coastal landscape features can provide significant buffers from wind and wave action and storm surge generated by tropical storms and hurricanes. It is estimated that the storm surge of Hurricane Andrew was reduced along the central Louisiana coast about three inches for every mile of marsh. Forest canopies provided by forested wetlands can diminish wind penetration, reducing wind stress available to generate surface waves and storm surge. A January 26, 2006 report by the Working Group for Post-Hurricane Planning for the Louisiana Coast documents recent studies that confirm the benefits of trees to coastal protection. The study cites a US Army Corps of Engineers report that indi-

cates that overtopped levees located behind trees received little structural damage from Hurricane Katrina.

Inland wetlands can also improve water quality and provide temporary water storage areas, trapping and storing stormwater to reduce flooding. Although some wetland types can benefit from some sediments, other wetlands may be adversely affected. Long-term pollutant loads delivered by stormwater discharges can alter or destroy stable wetland ecosystems.

In order for wetlands to continue to provide desired water quality benefits, they must be protected from degradation. Cleaning pollutant laden sediments and excessive nutrients discharges prior to discharge to sensitive wetland areas can be accomplished by utilizing a stormwater management plan that includes best management practices (BMP) to reduce uncontrolled pollutant loads delivered by stormwater discharges. Both stormwater BMBs that discharge to wetlands and BMPs that do not discharge to wetlands must be implemented to protect the wetlands.

Trees can be an integral part of a community's best management practices. Trees can be used to increase soil stability, increase soil microbial activity that aids in processing of nutrients and agricultural chemicals, develop effective buffers to

trap sediment and provide cover and food for wildlife.

Direct benefits of trees are usually associated with reduced energy costs. The American Public Power Association estimates that air conditioning costs can be reduced by up to 50 percent by proper shading of windows and walls of a home with landscaping. Heating costs can be reduced by strategically placed wind breaks. The US Department of Agriculture estimates that the net cooling effect of a young, healthy tree is equivalent to ten room-size air conditioners operating 20 hours a day. Trees increase the value of a home as they mature. Landscaped homes are more valuable and sell quicker than un-landscaped homes.

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Economic Benefits

The indirect economic benefits of trees can be even greater to a community and region and are realized in lowered electricity bills paid by customers, reduced use of fossil fuels to generate electricity and fewer measures to control air pollution.

Trees benefit business districts and consumer patronage. According to Kathleen L. Wolf, Ph.D., studies have shown that business district visitors prefer large trees and shoppers are willing to pay 9-12% more for products in districts with mature trees. Seventy four percent of the public preferred to patronize commercial establishments whose structures and parking lots

Benefits of Trees

are beautified with trees and other landscaping according to a study of one southern community.

Following is a list of the benefits of trees from the National Arbor Day Foundation web site:

The Value of Trees to a Community

"Landscaping can reduce air conditioning costs by up to 50 percent, by shading the windows and walls of a home." — American Public Power Association

"If you plant a tree today on the west side of your home, in 5 years your energy bills should be 3% less. In 15 years the savings will be nearly 12%." —Dr. E. Greg McPherson, Center for Urban Forest Research

"One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the annual needs of 18 people."—U.S. Department of Agriculture

"There are about 60 to 200 million spaces along our city streets where trees could be planted. This translates to the potential to absorb 33 million more tons of CO2 every year, and saving $4 billion in energy costs."—National Wildlife Federation

"Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20 - 50 percent in energy used for heating."—USDA Forest Service

"Trees can be a stimulus to economic development, attracting new business and tourism. Commercial retail areas are more

attractive to shoppers, apartments rent more quickly, tenants stay longer, and space in a wooded setting is more valuable to sell or rent."—The National Arbor Day Foundation

"The planting of trees means improved water quality, resulting in less runoff and erosion. This allows more recharging of the ground water supply. Wooded areas help prevent the transport of sediment and chemicals into streams."—USDA Forest Service

"In laboratory research, visual exposure to settings with trees has produced significant recovery from stress within five minutes, as indicated by changes in blood pressure and muscle tension."—Dr. Roger S. Ulrich Texas A&M University

"A mature tree can often have an appraised value of between $1,000 and $10,000." —Council of Tree and Landscape Appraisers

"In one study, 83% of realtors believe that mature trees have a "strong or moderate impact" on the salability of homes listed for under $150,000; on homes over $250,000, this perception increases to 98%." —Arbor National Mortgage & American Forests

"Landscaping, especially with trees, can increase property values as much as 20 percent."—Management Information Services/ICMA

"Healthy, mature trees add an average of 10 percent to a property's value."—USDA Forest Service

Benefits of Trees

"Nationally, the 60 million street trees have an average value of $525 per tree."—Management Information Services

The Center for Urban Horticulture at the University of Washington, College of Forest Resources, reports on a study by Weyerhaeuser that states that 86 percent of real estate appraisers surveyed agreed that landscaping added to the dollar value of commercial real estate and even more agreed that landscaping enhances sales of commercial real estate. One study in comparing 30 variables including architecture and urban design suggests that "landscape amenities have the highest correlation with occupancy rates; even higher than direct access to arterial roads".

Researchers have found a 30 percent difference in appraised value based upon the amount and variety of tree cover.

Studies indicate that developers can maximize profits by retaining existing trees or replanting trees after construction is complete. Researchers have found a 30 percent difference in appraised value based upon the amount and variety of tree cover.

Value of Community Trees

The urban forest in Terrebonne Parish has a value. By placing a compensatory value on the urban forest, decision makers will better understand the need to protect and enhance this valuable community resource. The Council of Tree and Landscape Appraisers has established a method of valuation that estimates the amount of payment to owners for the loss of an individual tree and views trees as a structural asset. Compensatory values can be used to estimate actual or potential loss caused by catastrophic events such as hurricanes, coastal erosion, fires and insect infestations.

July 2002, Louisiana's urban forest has an estimated compensatory value of $43.27 billion

The valuation method established by the Council of Tree and Landscape Appraisers estimates values based upon replacement costs and is an approximation of the structural asset value of a tree based upon a specific species, size, condition and location. The greater the compensatory value of the forest, the greater the ability of the forest to produce functional benefits such as aesthetics, pollution removal and cooling. According to a study in the Journal of Arboriculture 28(4): July 2002, Louisiana's urban forest has an estimated compensatory value of $43.27 billion, with 25.3 percent of urban tree cover which makes up 4 percent of the state.

Trees provide value by reducing stormwater runoff . A healthy mature 100-foot tree can take 11,000 gallons of water from the

Value of Community Trees

- ***A healthy mature 100-foot tree can take 11,000 gallons of water from the soil and release it into the air in a growing season.***
- ***Trees capture between 7 to 22 percent of precipitation.***
- ***For every tree, two cents in water control costs are saved for every gallon of water captured during a twelve-hour storm***

soil and release it into the air in a growing season. Trees capture between 7 to 22 percent of precipitation. The value of trees can be measured as the reduction in the amount of water detention structures that would be needed to offset these natural benefits. It is estimated that for every tree two cents in water control costs are saved for every gallon of water captured during a twelve-hour storm which can equate to real savings for a community.

In order to fully understand the value of trees to Terrebonne Parish it is recommended that a study be undertaken to establish the value of its community trees including benefits to storm water detention, preservation of the coast and hurricane protection.

Tree Costs

The benefits of trees and the urban forest do not come without some costs. Costs include the investment required to purchase and install the tree, the amount of maintenance required and costs associated with their conservation. Neglected, unprotected, abused or poorly maintained trees can add additional costs in increased risk management and liability. Utility crews, builders, developers and homeowners can unintentionally damage trees scheduled for conservation that can require additional maintenance or removal.

Tree surveys, evaluations and master plans are costs associated with planning for trees. Proper planning and design can eliminate additional future costs of mature trees that were planted improperly and require excessive pruning or early removal. Improperly planted trees that grow larger than expected may intrude into utility lines, pedestrian walkways, buildings, streets, reducing clearance and sight distance and cause increased costs to maintain public safety.

Tree roots can penetrate underground water and sewer lines through small cracks or pipe joints causing problems to homeowners and adding to parish utility department maintenance tasks. Cracking and heaving of sidewalks, curbs and street pavement can also result from improper species or placement. Improperly maintained trees can drop limbs on utility lines

causing service outages, damage vehicles, homes, fences and personal injury.

Although there are costs associated with trees, the benefits are greater and can be further improved with the implementation of Best Management Practices (BMPs).

Best Management Practices

Everyone can play a role in the best management of trees in Terrebonne Parish's community forest. Elected officials develop policies and laws on tree planting, care and maintenance. Government policies can include employee training to avoid tree damage during maintenance of drainage and utility lines. Laws can include ordinances on public tree care and maintenance, landscape guidelines for new developments and beneficial use of trees in mitigating the effects of stormwater runoff. Local government manages the risk management of hazardous trees and budgets funds for tree management, training and tree planting and removal.

Developers can preserve desirable trees during construction and plant and maintain new trees after developments are completed to mitigate losses as a result of construction activities. Homeowners can preserve and plant trees on private property that will contribute to the community forest. The Terrebonne Parish Tree Board and LSU AgCenter can provide public information to assist the parish in preservation, planting and maintenance of trees.

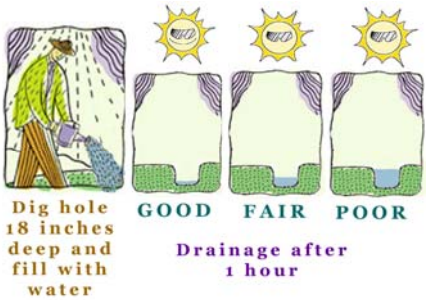
Best Management Practices or BMPs for community trees are guidelines that are the most effective and practicable means of preserving, selecting, planting and caring for community trees. The following Community Tree BMP's are intended for use by

parish officials, developers, landscape professionals and the public to improve the overall health and vigor of Terrebonne Parish's community forest.

Tree BMP's include site evaluation and design considerations, tree selection, tree planting and maintenance, identifying and addressing tree hazards and tree preservation and conservation during development and selecting hurricane resistant trees.

- Site Evaluation and Analysis
- Design Considerations
- Tree Selection
- Planting and Maintenance of Trees
- Tree Hazards
- Tree Preservation and Conservation
- Selection of Hurricane Resistant Trees

Site Evaluation



Evaluating the site is the first step in any tree planting, tree preservation or land development activity. Site evaluations will identify site conditions based upon the ultimate use of the property for residential or commercial or industrial purposes and may dictate the size or species of the trees to be preserved or planted.

How close to the surface is the water table? In Terrebonne Parish, the water table can be very close to the surface. In this in-

stance, choosing the correct tree will avoid future maintenance issues with tree roots breaking paving and affecting underground utilities. Site evaluations can be made with regard to the proposed use of the property. The location of overhead and underground utility lines, surrounding land uses, proposed ingress and egress and building and use areas can affect the location and type of trees planted.

Site Evaluation/Analysis

Size and health of existing trees

Site drainage and water table

Soil Conditions

Direction of north

Sun/shade

Coastal issues;

Surrounding land use

Good views / bad views

Availability of irrigation

Existing and proposed utility lines

Proposed building and vehicle use areas

Future ingress and egress

Possible planting location: parking lot, sidewalk cutout, lawn

Regulations

Safety considerations;

Signage

Site evaluations may include above and below ground conditions as well as environmental and urban factors. Design considerations will use the site evaluations to assist in preserving existing trees and selecting the right tree. What existing trees should be preserved? Preserving trees should be strongly considered before undertaking any construction activity. Existing trees have value and can add a finished look to any landscape. An existing live oak may become the focal point for future landscaping. Is there a need to block objectionable views or north winds? If so, evergreens may be considered.

Note: For a more detailed site analysis form see Additional Resources Section of this report.

How the site will ultimately be used will also have a bearing on tree placement and preservation, i.e., proposed building locations, circulation and parking, active play areas, passive recreation, and safety issues.

Design Considerations

Design considerations can include developing landscape areas as a series of outdoor "rooms" sized according to the use of the space with the enclosure provided by plants and buildings. Using trees to separate parking and vehicle circulation can be evaluated during this planning and design consideration stage. Public, semi-public and private spaces can be planned during the site evaluation and design consideration stage.

Tree attributes:

Function
Form
Texture
Color
Seasonal interest
Branching
Deciduous/Evergreen
Canopy Density
Longevity
Wood strength
Drought tolerant
Wildlife food / habitat
Shade

Selecting the right tree for the right location is essential. Site evaluations and design considerations are used to assist in making tree selections. Since trees are growing organisms and will change over time, consideration must be given to the mature size of the proposed tree including both above ground crown and underground roots and the seasonal changes of the plant.

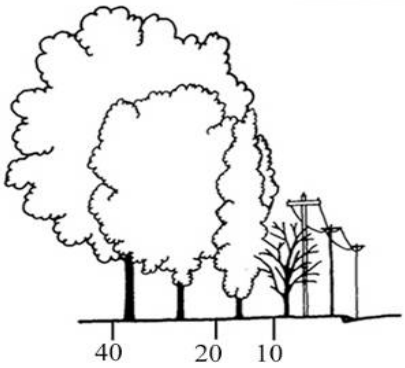
Trees used as a windbreak or for privacy can be evergreen. Trees used for shade may be deciduous and have a spreading form to allow the sun's warming rays to penetrate in the winter. Trees planted within 1/4 mile of salt water coastlines should be salt tolerant.

Tree Selection

Location of overhead wires will dictate a specific size tree for planting to avoid future maintenance costs of pruning for overhead wires and security lights.

Tree selection criteria may include tree function, form and size, species, site conditions and rate of growth. Is there enough planting area and volume of soil available for tree growth? Trees that are intended as focal elements may have an interesting form or some specific seasonal interest. Choose a small spreading tree in a location with overhead utility lines. Select narrow or columnar form trees to provide a screen between buildings.

Selecting the correct tree will reduce future maintenance costs and possible early removal costs. In any event, high quality nursery stock is essential to successful landscape plantings.



Distance from wire/ light*	Tree size at maturity
0-6 feet	Planting not recommended
6-40 feet	10ft less than wire/light Or Canopy diameter is less than twice the distance to wire/light

Source: University of Florida Institute of Food and Agricultural Services, "*Florida Trees for urban and suburban sites"* Retrieved July 16, 2007 from: http://orb.at.ufl.edu/FloridaTrees/.

Urban factors to consider when selecting trees:

Signs: plant large trees near low signs and small trees near tall signs.

Buildings: plant small trees and trees with narrow canopy within 10 feet of a building.

Vandalism: select trees 4 inches in diameter in areas prone to vandalism. Consider protecting trunks with tree guards.

Cleanup: Do not select trees with hard fleshy fruit near sidewalks or parking.

Regulations: consider existing tree regulations.

Evaluating the site, and applying appropriate design considerations will assist in selecting the appropriate tree. This along with proper planting and maintenance of trees will insure success of the project.

The best time to plant a tree is during the dormant season after leaf drop and before budbreak in spring. In Terrebonne Parish, trees can be planted most any time of the year provided that sufficient water is available and proper handling during transportation is exercised.

Prior to planting, locate all underground utilities. This is done by calling Louisiana One Call at least 96 hours (4 days) prior to digging. Terrebonne Consolidated Government is a member of Louisiana One Call.

Tree Planting & Maintenance

Planting and Maintenance of Trees

Don't Top Trees

Use Pruning Rules

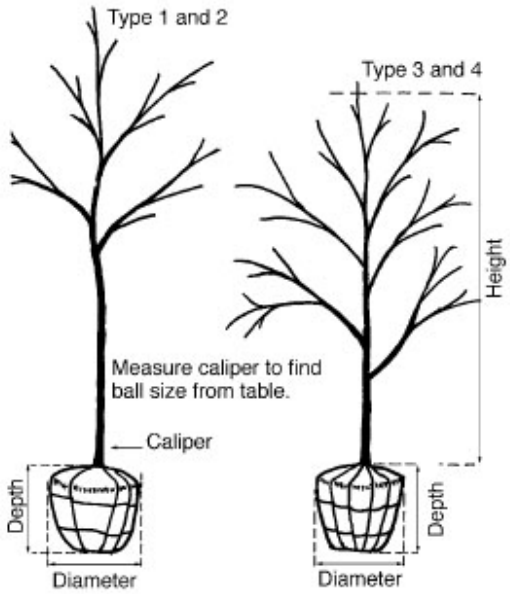
Make Proper Pruning Cuts

Use Mulch

Preserve Tree Roots

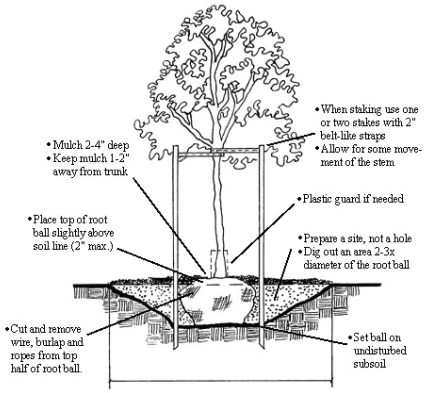
Prevent Girdling

Bare root or balled tree root systems have been reduced significantly from its original size and as a result the tree may exhibit transplant shock. Transplant shock is indicated by slow growth and possible leaf drop. Proper site preparation before and during planting along with good follow up care can reduce the amount of time the plant will experience transplant shock and quickly establish in its new location.



Trees should meet the standards set for nursery stock by the American Association of Nurserymen. The complete publication can be found on line at:http://www.anla.org/applications/Documents/Docs/ANLAStandard2004.pdf.

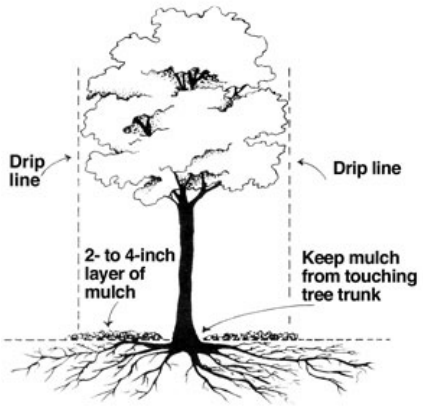
Tree Planting & Maintenance



Following is a list of best management practices for successful tree plantings:

- *Trees should be transported to the site in a covered vehicle to prevent wind burn and checked for moisture at arrival*
- *On-site plant material should be maintained under shade and irrigated twice daily.*
- *Ball and burlap plants should be healed in to avoid drying.*
- *Trees should be protected from extreme temperatures*
- *Always handle the tree by the root ball using straps. Do not lift using branches or the trunk.*
- *Dig a shallow, broad planting hole 2 to 3 times wider than the root ball and plant the trunk flare 2-3 inches above the soil line.*
- *For container trees, carefully remove the tree from the container and inspect the roots ball for circling roots.*
- *Backfill with soil from the hole amended uniformly about one third full and gently but firmly pack the soil around the base of the root ball.*
- *Straighten tree as backfill is added.*
- *Remove synthetic wraps, rope, twine, etc. from the tree ball, careful not to damage the root ball, trunk or roots. Loosen burlap from around tree.*
- *Fill the remainder of the hole, packing soil firmly to eliminate air pockets. Add soil a few inches at a time and settle with water.*
- *Irrigate with 10-20 gallons of water to the root ball and surrounding backfill.*
- *Apply 2-4 inches of mulch, including leaf litter, pine straw, shredded bark or peat moss, to the area at the base of the tree. Do not pile much against the trunk of the tree.*

It is not recommended to apply fertilizer at the time of planting a tree.



- *Staking is not necessary in most home situations. Protective staking may be warranted where lawn mower damage, vandalism or windy conditions are concerns.*
- *Provide trees with regular irrigation. Establishment period is about 6 months for each inch tree caliper (ex. 3"=18 months establishment period).*
- *Two to three gallons of water is required for each caliper inch of tree. Irrigation is applied to the root ball.*
- *Pruning should be done at the nursery. Prune any branches damaged in transportation. No pruning is needed for the first year after planting.*
- *Maintain mulch area surrounding tree and limit traffic to prevent compaction.*
- *Remove grass and weeds from mulched area.*
- *Remove all stakes and guying materials after the first year.*
- *Prune after year 2 to remove lower limbs to lift canopy.*

Source: International Society of Arboriculture

Size of nursery stock	Irrigation schedule for vigor	Irrigation schedule for survival
< 2 inch caliper	Daily: 2 weeks Every other day: 2 months Weekly: until established	Twice weekly for 2-3 months
2 – 4 inch caliper	Daily: 1 month Every other day: 3 months Weekly: until established	Twice weekly for 3 – 4 months
> 4 inch caliper	Daily: 6 weeks Every other day: 5 months Weekly: until established	Twice weekly for 4 – 5 months

Source: Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida.

Mulching Trees

Mulching mature trees can provide many positive results including providing a stable root environment, retaining moisture for valuable feeder roots and preventing damage due to lawn mowers and weed eaters and reduced competition from weeds and grass.

In order to be most effective, mulch should be placed 2-4 inches deep over the entire root system which extends out sometimes as far as 2-3 times the diameter of the drip line.

Topping

Topping hurts trees. It is possibly the most harmful tree pruning practice. Topping is the cutting of branches to stubs to reduce the size of a tree or as in some cases such as Crape Myrtles, topping is practiced to encourage more blooms. Some top trees to reduce the potential of hazard, but the effect can make a tree more hazardous.

Topping Hurts Trees
Topping Stresses Trees
Topping Causes Decay
Topping Can Lead to Sunburn
Topping Creates Hazards
Topping Makes Trees Ugly
Topping is Expensive

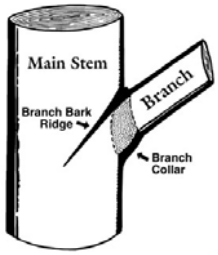
Topping stresses trees. The severity of pruning triggers a survival mechanism in the tree activating dormant buds forcing rapid growth of multiple shoots below the cut. A new crop of leaves is needed and if a tree does not have enough stored reserves, it may seriously weaken and possible die as a result. The tree is put under stress and stressed trees are more vulnerable to insect and disease infestations.

Alternatives to topping include cutting back branches to their point of origin or to a lateral branch that is large enough to assume the terminal role. Exercise care when pruning trees. Pruning large trees can be dangerous. When pruning above the ground or using power equipment, it is best to hire a professional licensed arborist to assist.

New shoots develop profusely below a topping cut.

The American National Standards Institute (ANSI) A-300 Pruning Standards and International Society of Arboriculture (ISA) Best Management Practices for Pruning are the leading tree care industry pruning standards.

There are currently six ANSI A300 standards - for pruning, cabling and bracing, tree fertilization, lightning protection, management of trees and shrubs, and transplanting. A seventh, Integrated Vegetation Management, is in the works. The A300 Standards were developed so arborists and plant maintenance managers can write accurate work specifications that follow accepted tree care industry practices. With written work specifications you can compare "apples to apples."



Pruning is very important to the management of the urban forest and is often overlooked due to its cost. Proper pruning can extend the health, safety and life of trees and are the reasons for establishing policies for pruning trees.

Storm Resistant Trees

Resistance of tree species to hurricane-related damage
(in descending order of resistance)

Flood Tolerant	Breakage	Uprooting	Salt	Deterioration by Insect and Disease
Bald cypress	live oak	live oak	live oak	live oak
Pond cypress	palms	palms	palms	palms
tupelo-gum	Bald cypress	Bald cypress	slash pine	sweetgum
sweetbay / willow	Pond cypress	Pond cypress	longleaf pine	water oak
Sweetgum	sweetgum	tupelo-gum	Pond cypress	sycamore
sycamore	tupelo-gum	Red cedar	loblolly pine	Bald cypress
river birch	mimosa	sweetgum	Red cedar	Pond cypress
cottonwood	dogwood	sycamore	tupelo-gum	southern red oak
green ash	magnolia	longleaf pine	Bald cypress	magnolia
red maple	sweetbay	mimosa	sweetgum	tupelo-gum
pecan	southern red oak	southern red oak	water oak	sweetbay
mulberry	water oak	magnolia	sycamore	hickory
American elm	sycamore	slash pine	sweetbay	pecan
persimmon	longleaf pine	loblolly pine	southern red oak	red cedar
silver maple	slash pine	sweetbay	hickory	red maple
water oak	loblolly pine	water oak	mimosa	mimosa
swamp chestnut	redcedar	red maple	pecan	dogwood
magnolia	hickorry	dogwood	magnolia	longleaf pine
hickory	red maple	hickory	red maple	slash pine
	pecan	pecan	dogwood	loblolly pine

HIGH — LOW

HIGH — LOW

Made available by: Barton Joffrion, County Agent Terrebonne Parish
Louisiana State University Agriculture Center

For more information on storm resistant trees see Appendix for Additional Resources.

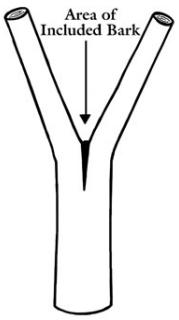
Storm Resistant Trees

Storm Resistant Trees

Other factors can influence tree damage as a result of hurricanes including the amount of rain prior to heavy winds, shallow or low aerated soils. The lack of volume of soil can limit root growth and create instability in trees making them more susceptible to damage from storms.

To determine which trees do best to resist storm damages due to high winds and hurricanes, take a look at the trees growing in the area, visit local nurseries and asses the site conditions such as soil conditions and water table that may affect tree growth before choosing a species to plant. Native trees with wide spreading branches, low centers of gravity, strong penetrating roots and small leaves appear to hold up better in tropical storms and hurricane force winds. Trees planted in clumps survive better than single trees.

In parts of Terrebonne parish, salt water intrusion due to flooding can be a problem. Ask for trees that are more tolerant to salt water when selecting a tree to plant.



Proper tree selecting handling and maintenance can improve tree survival in severe storms. Pruning co-dominant branches and one side of forked branches with tight or narrow crotches early in a tree's life before trees become too large will reduce the chance of splitting and cracking in high winds. Proper wa-

tering, fertilization and mulching and avoidance of damage to the roots and trunks will also prepare the tree to weather the worst possible storm.

Recognizing Tree Hazards

A tree hazard refers to any potential tree failure due to a structural defect that may result in property damage or personal injury. A defective tree is hazardous only when its failure could result in damage to something of value. Because all trees have some chance of failure, it is not feasible to eliminate all tree hazards. To protect the parish from liability, it is necessary to use "reasonable care" to protect the public.

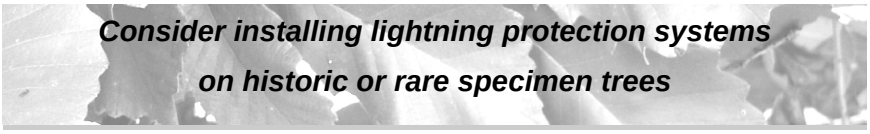
Best Management Practices for Community Trees can assist the parish in developing policies for exercising reasonable care with regard to managing tree hazards.

Classifying Tree Hazards

Tree Hazards can be classified according to symptoms. Each hazard category has unique symptoms that have a probability for failure. The more defects exhibited, the increased probability of failure of the tree.

Following is a list of categories by symptoms:

Dead Trees: The most dangerous type of tree hazard. Once a tree dies, tree decay weakens the tree structure most rapidly in the root system where moist conditions favor decay. Structural weakening increases over time.



Recognizing Tree Hazards

Tree Hazards

High Risk *—High use areas with concentrations of people, parked vehicles and permanent structures. Highest priority for regular inspections.*

Medium Risk *— Intermittent use by people and moving vehicles. Priority for inspections based on amount and type of use.*

Low Risk *—No vehicles or structures and low visitor use. Regular inspections have low priority.*

Source: http://www.na.fs.fed.us/spfo/pubs/hazardtrees/treehazards/eval.htm

Leaning Trees: These trees are only hazardous when the lean is a result of structural damage such as damage from a wind storm or hurricane. The greater the lean of the tree the greater the probability of failure.

Root Injuries: Roots function as an anchor providing resistance to wind. Root rotting fungi destroy wood fiber in the root system reducing strength and resistance to wind. Sporophores (mushrooms) around the base of the tree indicate advanced decay. Soil compaction due to vehicular or pedestrian traffic or construction activities and excessive fill or water ponding can increase root system injury.

Trunk Injuries: The trunk must support the weight of the crown and any injury increase chances of failure. Trunk wounds provide entry for wood rotting fungi. The thickness of sound wood in the outer shell determines the structural strength of the tree.

Insect Activity: Since insect infestation could be a sign of a weakened tree due to other causes including root disease, all insect affected trees should be carefully evaluated.

Crown Defects: Only a small percentage of tree failures occur in the tree crown. The major hazard of crown defects is the potential for falling limbs in older trees such as Water Oaks or Cottonwoods.

Recognizing Tree Hazards

Tree Inspections

It is important to inspect for hazardous trees. Heavily-used areas such as the parks and playgrounds should be inspected annually prior to the recreation season. Public green spaces such as the courthouse square or other public gathering place should also be inspected on an annual basis. Additional inspections are warranted following severe storm activity.

Dead, split, and broken branches should be eliminated before they cause damage to people and property. Low-hanging, live branches should be removed so that they do not interfere with pedestrian and vehicular traffic. Branches that obscure clear vision of warning signs, traffic signals, or other traffic must also be removed.

Stump Removal

Consideration should be given to stump removal at the time of tree removal. The timetable for the completion of all maintenance tasks over a period of time will be determined by budget, personnel and equipment capabilities.

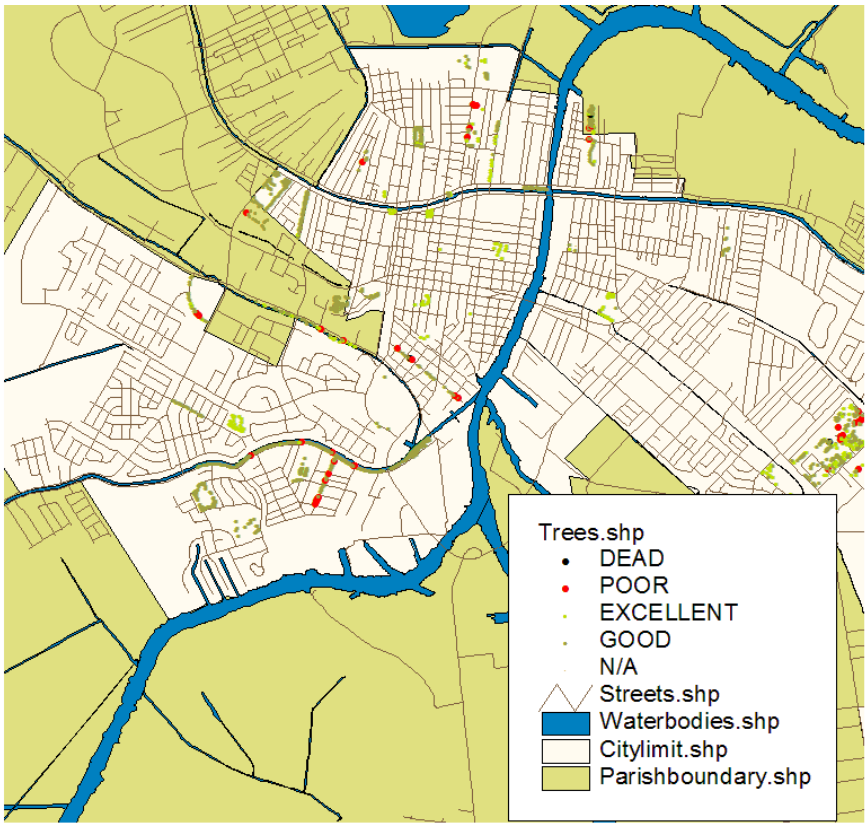
Composting

It is recommended that the parish institute a program to compost organic waste including tree debris, grass clippings and tree chipping as part of their parish-wide solid waste collection.

Tree Inventory

The parish recently completed a tree inventory of trees on public land in the Houma area of the parish. 2,287 trees were catalogued according to species, condition and size. This tree in-

ventory is a good start in identifying parish trees to implement a comprehensive tree management strategy for parish community trees. 1,917 trees were found to be in good condition. 314 trees were determined to be in excellent condition with 47 considered in poor condition. Five trees were found to be dead.



Stormwater Management

Implementation of the Water Pollution Control Act as amended in 1972 and commonly referred to as the Clean Water Act has achieved much success in controlling water pollution from point sources including municipal wasterwater treatment plants and industrial discharges. Non point source pollution including runoff from agricultural lands, sediment from improperly managed construction sites, bacteria from livestock and faulty septic systems, urban storm water runoff from parking, roadways and lawn care chemicals is a main contributor to much of the current water quality problems in streams, drinking water sources and other water bodies.

Non Point Source Pollution:

- *Residential application of pesticides is typically at a rate 20 times that of farmers per acre; it results in many unintended results.*
- *A lawn has less than 10% of the water absorption capacity of a natural woodland - a reason for suburban flooding.*

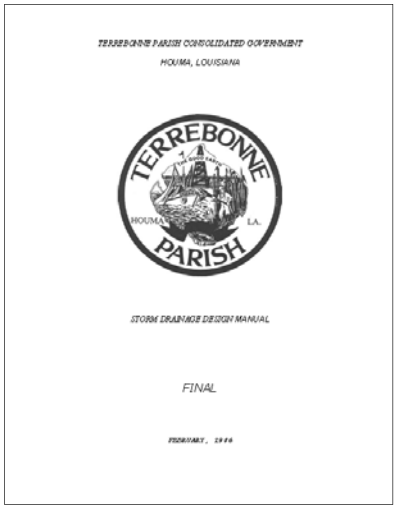
In 1990, the EPA issued the Phase I stormwater rule (55 FR 47990; November 16, 1990) requiring NPDES permits for operators of municipal separate storm sewer systems (MS4s) serving populations greater than 100,000 and for runoff associated with industrial activity, including runoff from construction sites of5 acres and larger. In 1999, the EPA issued the Phase II stormwater rule (64 FR 68722; December 8, 1999) that expanded the requirements to small MS4s in urban areas and to construction sites between 1 and 5 acres in size.

The EPA has delegated NPDES permitting authority to Louisiana. NPDES permits are reissued every five years. Permits require each permittee to develop a stormwater managmentn plan

that details how stormwater discharges will be controlled. A Stormwater Management Plan or Stormwater Pollution Prevention Plan should include strategies and BMP's for:

- *Outreach*
- *Education*
- *Construction*
- *Post-Construction*
- *Illicit Discharges Elimination*
- *Pollution Prevention*

Terrebonne Parish has developed two ordinances to address stormwater. The *Storm Drainage Design Manuel* , February 1986, addresses flood control and detention. The *Terrebonne Parish Design Manuel for Stormwater Drainage and Detention*, June 2006, addresses the issues of stormwater to reduce stormwater non point source pollution. Additionally, Chapter 9 Flood Damage Prevention, of the parish code of ordinances provides specific requirements to minimize public losses due to flood conditions in all areas of special flood hazard as identified by the Federal Emergency Management Agency within the parish and the City of Houma.


TERREBONNE PARISH CONSOLIDATED GOVERNMENT
HOUMA, LOUISIANA
TERREBONNE PARISH
STORM DRAINAGE DESIGN MANUAL
FINAL

These requirements address regulatory mechanisms to implement stormwater management controls by restricting altering natural floodplains, stream channels and natural protective barriers and control filling, grading and dredging on other development which may increase flood damage. These regulations are primarily structural devices.

Stormwater Management

- *Fayetteville, Arkansas: increasing tree canopy from 27-40% reduced their storm water runoff by 31%*
- *South Miami residential study found that a 21% existing tree canopy reduces the storm water runoff by 15%*
- *For every 5% of tree cover added to a community, storm water is reduced by approximately 2%*

Source: Trees and Their Role in Storm Water Management. Mindy Habecker, http://www.hort.wisc.edu/mastergardener/

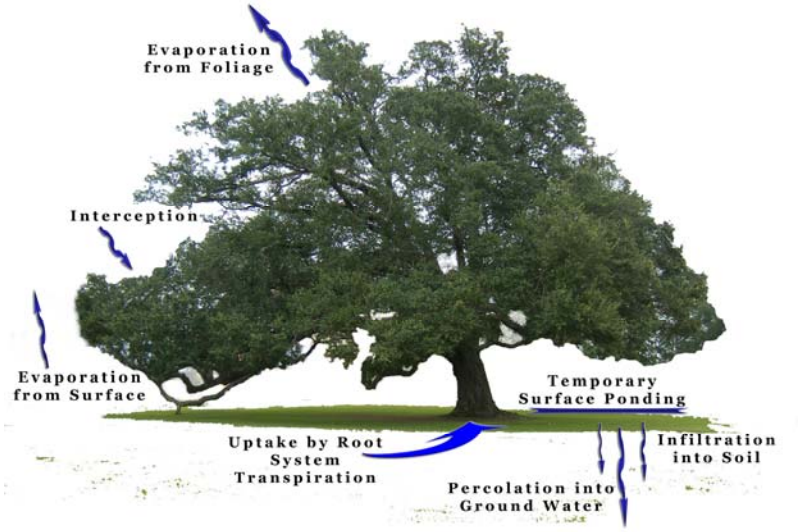
Trees and vegetation can become a part of the public utility providing additional benefits to reduce erosion and flooding and non point source pollution. Trees can help reduce the cost of structural stormwater management including land acquisition costs and construction of stormwater retention facilities.

In Milwaukee, the existing tree cover reduces stormwater flow by up to 22 percent and provides the city an estimated $15.4 million in benefits. The City of Roanoke, Virginia used CITYGreen to measure cost savings associated with its tree canopy. Roanoke's 32 percent tree canopy provides 64 million cubic feet in stormwater retention capacity, valued at $128 million (based on construction costs estimate at $2/cu.ft.). Based upon study results, the city council passed a 40% tree canopy goal as part of the city's comprehensive plan. Trees perform a variety of functions that help reduce the amount and rate of stormwater runoff. While all trees perform these functions, trees with the following characteristics may perform them better than others:

- persistent foliage
- canopy spread
- longevity
- growth ratedrought tolerance
- tolerance to saturated soils
- resistance to urban pollutants (air and water)
- tolerance to poor soils
- root pattern
- bark texture
- foliage texture
- branching structure
- canopy density.

Stormwater Management

Roanoke's 32 percent tree canopy provides 64 million cubic feet in stormwater retention capacity, valued at $128 million



Simply put, more trees means less stormwater runoff. The following list of why trees should be part of a stormwater management plan was compiled in the American Forests publication *Stormwater Phase II Action Alert*: [i]

> *Trees slow stormwater flow, reducing the volume of water that must be managed in urban areas and decreasing the amount of runoff that containment facilities must store.*
>
> *Trees intercept rainwater on leaves, branches and trunks, slowing its movement into channelized drainage areas.*
>
> *Stormwater volume is diminished when some intercepted water evaporates into the atmosphere and some soaks into the soil. The net reduction in total volume and peak flow lessens the potential for flooding, a critical concern during heavy rains.*

[i] STORMWATER PHASE II ACTION ALERT, downloaded September 25, 2007 **http://www.americanforests.org/downloads/graytogreen/stormwaterII.pdf**

Stormwater Management

Trees provide their greatest benefit during light rains by increasing soil permeability, which facilitates groundwater recharge. Reducing impervious surfaces and increasing tree cover promotes the movement of water into the water table.

Long-term studies document trees' ability to reduce the movement of stormwater and cut peak flow rates that cause flooding and overtax stormwater sewers. The Natural Resource Conservation Service has measured the effects of stormwater movement across various land covers over the last 50 years. Based on these studies, engineers developed predictive models that calculate the volume of water produced from a given rainstorm and land cover (TR-55: Urban Hydrology of Small Watersheds). Stormwater management facilities' construction costs are calculated based on these models.

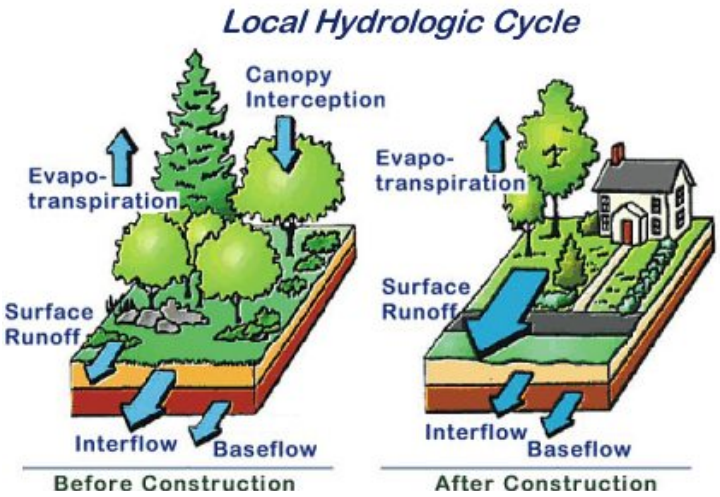


Image Source: Maryland Department of the Environment, http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/home/index.asp

Stormwater Management

Urban areas could reduce their stormwater runoff and save millions of dollars by increasing their tree cover. In Fayetteville, Arkansas, increasing tree canopy from 27% to 40% would reduce their stormwater runoff by 31% valued at an additional $43 million in capital improvement savings (represents $2/cubic ft. cost to contain stormwater runoff. American Forests, UEA of Benton and Washington Counties, Arkansas, 2002) [i]

[i] STORMWATER PHASE II ACTION ALERT, downloaded September 25, 2007 **http://www.americanforests.org/downloads/graytogreen/stormwaterII.pdf**

Title	Members	Responsibilities
Principal Permittee / Operator	Terrebonne Parish Consolidated Government	Ensure SWPPP Implementation
		Submit a Notice of Intent (NOI) in accordance with the requirements of Permit No. LAR100000, Part II, at least 48 hours prior to the commencement of construction activities[1]
	Program Manager	Manage the SWPP Implementation
		Coordinate with the Consultant(s) and Contractor(s) to ensure that construction activities are performed in compliance with the SWPPP and the LPDES permit
Consultant(s)	Project Design Consultant(s)	Incorporate appropriate control measures (best management practices (BMPs) into projects to prevent pollution of storm water runoff.
		Identify additional BMPs if site conditions warrant.
		Prepare a project specific SWPPP as per this document.
Contractor(s)	Construction Contractor(s)	Comply with the provisions of the SWPPP
		Implement and maintain control lmeasures (BMPs) to prevent pollution of storm water runoff.
		Identify and implement additional BMPs if site conditions warrant.
Co-Permittee / Contractor	Construction Contractor(s)	File a separate Notice of Intent (NOI), identifying the Contractor as a co-permittee, at least 48hours prior to starting construction.1
Note: Permit No. LAR100000. Part's I.B.1.c, I.B.2, and II.A.1-4 describes Notification Rquirements related to Notice of Intent (NOI) submittal.		

Stormwater Management

Based upon the management structure of the current Terrebonne Parish Storm Water Pollution Prevention Plan (SWPPP) for Construction Activities, the Terrebonne Parish Program Manager and parish government are responsible for managing and ensuring implementation of the SWPPP. The parish program manager coordinates with the consultants and contractors to insure that construction activities are performed in compliance with the SWPPP and the LPDES permit.

It is the responsibility of the project design consultant to incorporate appropriate control measures, Best Management Practices (BMPs) into projects to prevent pollution of stormwater runoff and to identify additional BMPs if site conditions warrant and prepare a specific SWPPP as per the ordinance.

The contractor is responsible for implementing and maintaining control measures and to identify and implement additional BMPs if site conditions warrant.

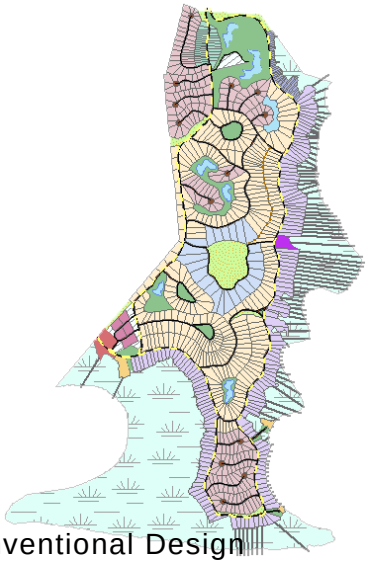
Specific BMPs are included in Attachment No. 2 which should be considered and selected by the consultant. These BMPs are structural and include erosion control mats, vegetative stabilization of disturbed areas, silt fencing, straw bale dikes, triangular sediment filter dikes, interceptor swales, check dams, inlet protections and other structural devices intended to reduce pollu-

tion from sediment and slow runoff.

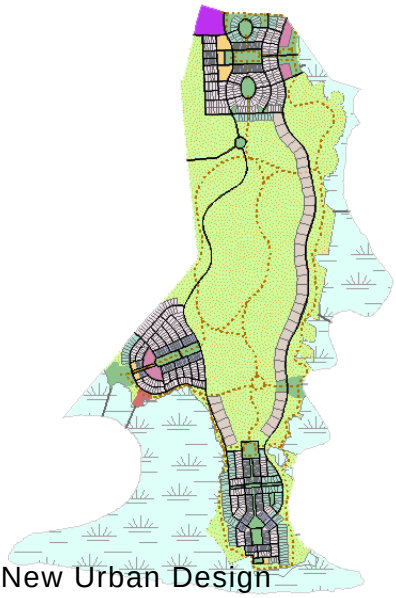
Non-structural methods are regularly scheduled activities or programmatic actions such as pollution prevention, watershed planning, natural vegetated buffer areas, street sweeping, inspections and improved materials handling practices. Outreach and education programs for pollution prevention practices to encourage proper recycling of yard trimmings, including trees and grassy swales in landscape ordinance are non structural methods of controlling pollution. A common program is storm drain stenciling to enhance public awareness. Non structural stormwater management practices should be used to the maximum extend practicable to minimize the reliance on structural BMPs.

There are many programs that seek to minimize the impact of land development. Nonstructural practices and design techniques play an important role in reducing water quality impacts and are a critical feature of any stormwater design.

Stormwater Management



Conventional Design



New Urban Design

For the past two decades the rate of land development across the country ahs been more than two times greater than the rate of population growth. In Terrebonne Parish land development patterns sprawl out from existing population centers into formerly agricultural lands increasing stormwater volume that degrade water quality adding to the harmful effects of coastal erosion.

Other non structural BMPs can include compact development and infill development as practiced by conservation design, smart growth and new urbanism principles to lessen the volume of stormwater runoff and offer better water handling benefits on-site.

Conservation Design

Source: New Urbanist Design: Point Peter Villages http://www.csc.noaa.gov/alternatives/urbanistStatic.html

A structural BMP is a physical device. These devices are designed and constructed to trap or filter pollutants from runoff, reduce runoff velocities, prevent soil erosion, conserve water, provide habitat, food and shelter for area wildlife. Structural BMP's include the following:

Infiltration Systems—capture runoff and allow it to infiltrate it into the ground.

Detention/Retention Systems—capture runoff and retain for subsequent release.

Stormwater Wetland Systems—similar to retention/detention systems containing wetland vegetation.

Filtering Systems—various filtration media such as sand, soil, mulch layers, carbon or membrane to remove pollutants from runoff.

Biofiltration Systems—designed to convey and remove pollutants from runoff via vegetated swales and strips.

Bioretention Systems—utilizes soils to slow the runoff velocity and utilizes trees and shrubs to remove pollutants from stormwater.

Hydrodynamic Systems—flow through structures with a settling or separation unit to remove sediments and other pollutants.

Manufactured BMP Systems—control measures designed and sized by manufacturers to intercept stormwater and prevent the transfer of pollutants down stream. These flow through structures are designed to regulate inflow as opposed to traditional BMP's designed to store entire water quality volume.

Stormwater Management

Recommended Actions

A comprehensive landscape ordinance that would require the use of trees in parking lots, buffer zones and retention/detention ponds to filter urban runoff and assist in efforts to reduce flooding. A landscape ordinance can also include requirements to preserve existing trees. These preservation and replanting efforts can be credited to developers toward meeting the requirements of the parish stormwater pollution prevention ordinance.

Include in Attachment No. 2 of the Terrebonne Parish Storm Water Pollution Prevention Plan (SWPPP) specific recommended uses of trees as an accepted method of reducing pollution from stormwater runoff. Also require preservation of natural riparian edges of streams and bayous as a part of the SWPPP.

10 Smart Growth Principles

1. *Create a range of housing opportunities and choices.*
2. *Create wallkable neighborhoods.*
3. *Encourage community and stakeholder collaboration.*
4. *Foster distinctive, attractive places with a strong sense of place.*
5. *Make development decisions predictable, fair, and cost effective.*
6. *Mix land use.*
7. *Preserve open space, farmland, natural beauty, and critical environmental areas.*
8. *Provide a variety of transportation choices of smart growth.*
9. *Strengthen and direct development toward existing communities.*
10. *Take advantage of compact building design.*

Source: Nisenson, Lisa, Using Smart Growth Techniques as Stormwater Best Management Practices, EPA Publication 231-05-002,

Appendix A

Additional Resources
Links

Additional Resources

"Become Carbon Neutral Today" http://www.carboncounter.org/offset-your-emissions/personal-calculator.aspx.

Center for Urban Horticulture, *"Urban Forest Values: Economic Benefits of Trees in Cities",* University of Washington, College of Forest Resources, 1998.

Head, Constance P., Fisher, Robinson, O'Brien, Maureen, "*Best Management Practices for Community Trees, A Technical Guide to Tree Conservation in Athens-Clarke County, Georgia",*

Nisenson, Lisa, Using Smart Growth Techniques as Stormwater Best Management Practices, EPA Publication 231-05-002,

The National Arbor Day Foundation, *"The value of Trees to a Community"*

Wikipedia, *List of Louisiana parishes by French-speaking population*http://en.wikipedia.org/wiki/List_of_Louisiana_parishes_by_French-speaking_population.

Working Group for Post-Hurricane Planning for the Louisiana Coast, *"A New Framework for Planning the Future of Coastal Louisiana after the Hurricane of 2005"*

Links

American Institute of Hydrology
www.aihydro.org

American Society of Landscape Architects
www.asla.org

Buffer Model Ordinance
http://www.stormwatercenter.net/Model%20Ordinances/buffer_model_ordinance.htm

Center for Watershed Protection
www.cwp.org

Florida Trees for Urban and Suburban Sites
http://orb.at.ufl.edu/FloridaTrees/index.html

Information on Watershed Assistance Grants,
www.rivernetwork.org

International Society of Arboriculture
http://www.isa-arbor.com/home.aspx

Make Wise Tree Removal Decisions before a Hurricane
http://www.lsuagcenter.com/en/lawn_garden/home_gardening/trees_shrubs/

National Arbor Day Foundation
http://www.arborday.org/trees/benefits.cfm

Natural Resources Defense Council
www.nrdc.org

"Stormwater News"
www.stormwater-resources.com

Texas Nonpoint SourceBOOK
www.txnpsbook.org

Appendix B

Site Analysis Form

Site Analysis Form

1. What USDA hardiness zone is the planting site located in?
2. What is the average annual rainfall in the area? Less than 20 inches or More than 20 inches
3. Will the tree be planted:
   In the ground, in containers or in above ground planters, or near the coast.
4. What is the light exposure at the site?
   More than 6 hours of full sun, between 2 and 5 hours of direct sun, two to five hours of sun with sig nificant reflected light, less than 2 hours of full sun, or filtered shade most of the day.
5. What is the soil pH at the planting site? Have it tested, don't guess.
6. How fast does water drain through the soil at the planting site?

   Test this by digging a hole 18 inches deep and filling it up with water. If the water drains away in an hour or two, the drainage is fast. If it takes up to a day for the water to drain away, drainage is moderate. If it takes longer than a day, the drainage is slow. Slow, moderate, or fast

1. What is the distance between the top of the water table and the soil surface?

   To test this, dig several holes on the site about 2 feet deep and wait 2 or 3 hours. If any water appears in the hole, the site probably has a high water table.

1. How will the site be irrigated?
   Hardly at all, during the establishment period only, during establishment and then only during extended drought, the trees will be regularly irrigated.
2. What is the soil texture?
   Clay, loam, or sand
3. What is the soil density?
   The soil is compacted and hard, or the soil is loose
4. Will the tree be planted in a tree lawn or streetscape (the grassy strip between the curb and the sidewalk)?

   If so, how wide is the tree lawn? 3 to 4 feet, 4 to 6 feet, 6 to 8 feet, or more than 8 feet wide

1. Will the tree be planted along a street without a sidewalk? If so, how far from the edge of the road will the tree be planted?
2. Will the tree be planted in a sidewalk cutout?
3. Will the tree be planted in a parking lot? If so, will it be planted in a sidewalk cutout, parking lot island, buffer strip or narrow linear strip of soil?
   For a parking lot island - what is the square footage of the parking lot island?
   For a buffer strip or linear strip - what is the width of the buffer strip or liner planting strip?
4. Will the tree be planted in an open lawn area or in a shrub bed? What is the approximate size of this area?
5. Will the tree be planted within 8 feet of a sidewalk, driveway or other hard surface?
6. Will an adjacent sidewalk or roadway receive deicing salts?
7. Is there a swimming pool, vegetable garden, masonry wall or septic tank or drain field within 50 feet of the

Source: University of Florida Institute of Food and Agricultural Services, "*Florida Trees for urban and suburban sites"* Retrieved July 16, 2007 from: http://orb.at.ufl.edu/FloridaTrees/.

planting site? I so, how far away is it?

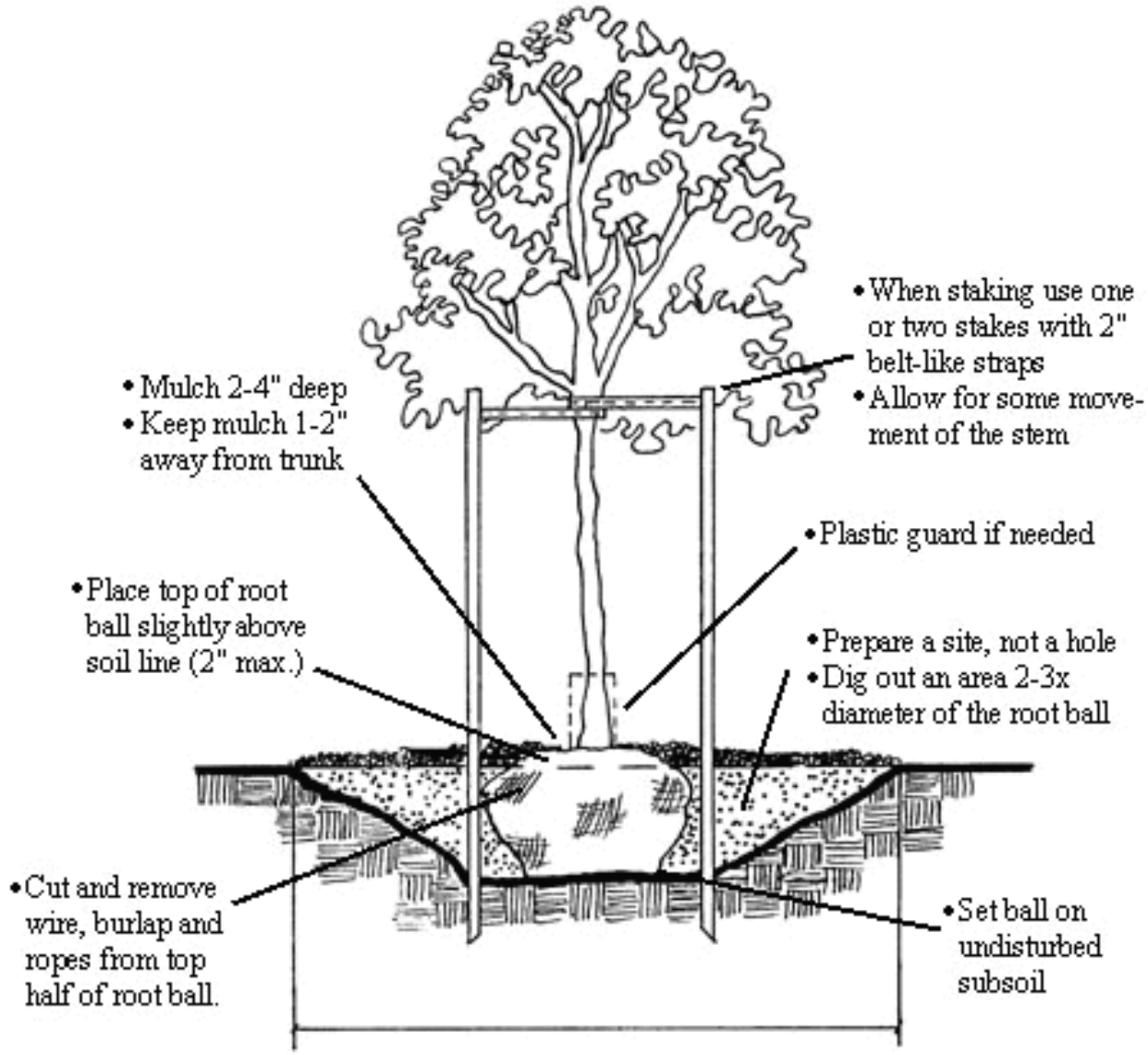
8. Are overhead wires within 30 feet of the planting site? If so, what is the horizontal distance between the planting hole and the wire? What is the distance between the ground and the lowest wire?
9. Is there a street light or security-type light within 35 feet of the planting hole? If so,
   Do you want the tree branches to stay clear of the light so they will not have to be pruned?
   Are you willing to provide some pruning to train the branches to grow over the light?
   What is the horizontal distance between the light and the planting hole?
   How tall is the light?
10. Is the planting site within 35 feet of a building? If so, what is the horizontal distance between the planting hole and the building? Approximately how tall is the building?
11. Would you care to eliminate trees that could drop messy fruit, large leaves or twigs during an extended period?
12. Would you like to eliminate trees that are known to be susceptible to breakage?
13. What is your budget for pruning trees?
14. Would you care to plant only native trees?
15. Please list any other attributes that you would like your trees to have?
16. Other considerations: 1) soil salt levels, 2) soil contamination, 3) soil layering, presence of construction debris, 4) health of and type of existing plants, 5) presence of underground utilities, 6) ordinance restrictions, 7) species diversity index, 8) politics, 9) community expectations, 10) design life of site, 11) tree life expectancy, 12) forest vs. former agricultural field, 13) location of existing tree roots, 14) recent construction activities.

University of Florida Institute of Food and Agricultural Services, "*Florida Trees for urban and suburban sites"* Retrieved July 16, 2007 from: http://orb.at.ufl.edu/FloridaTrees/site_analysis_detail.htm.

Appendix C

Tree Planting Detail

Tree Planting Detail



Appendix D

Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricanes Erin and Opal

University of Florida,
IFAS Extension

Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricanes Erin and Opal [1]

Mary L. Duryea[2]

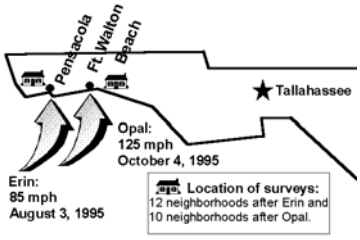
Hurricanes Erin and Opal swept across the Florida Panhandle in 1995 bringing with them sustained winds of 85 and 125 mph. In two surveys immediately following the hurricanes, 25 neighborhoods were inventoried for tree damage. This circular summarizes the results of our surveys and ranks the wind resistance of the North Florida tree species in these communities. Hurricane-susceptible communities should consider wind resistance as one of their criteria in tree species selection.

Introduction

When hurricanes strike land, along with damage to property such as houses, power lines, and commercial buildings, they may cause damage to trees in the urban forest. Yet, sometimes a fallen tree may be side-by-side with one which is standing and appears unaffected by the winds. This varied wind resistance by different trees may be due to many factors such as tree age, size, health, and species.

In 1995 two hurricanes impacted the Florida Panhandle. The first, on August 3, was Erin, a slow-moving hurricane which struck the Pensacola area with sustained winds of 85 mph. Two months later, on October 4, Opal moved through the Ft. Walton Beach area more quickly and had sustained winds of 125 mph. Three days after each hurricane we surveyed the damage to trees in neighborhoods where the eye of the hurricane had passed.

Methods



Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal*" Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

After Hurricane Erin, 12 neighborhoods in the Pensacola area--and after Hurricane Opal--10 neighborhoods near Ft. Walton Beach were inventoried for tree damage **(Figure 1)** .

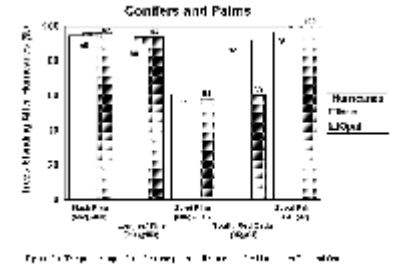
All trees along the neighborhood transects were observed and the following information was recorded: 1) Has the tree fallen? 2) If the tree fell, was it uprooted--or broken at the main stem? 3) If the tree fell, did the tree cause damage to property and if so, what kind of damage? 4) If the tree was still standing, did it have crown damage?

Results

What Tree Species Fell?

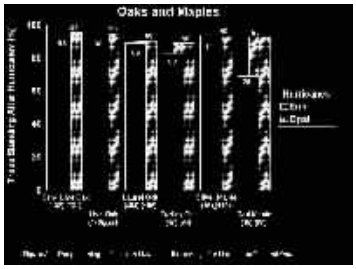
Erin and Opal. Observations were obtained for 2,443 trees after Hurricane Erin and 2,468 trees after Hurricane Opal. Of the 4,911 surveyed trees, 11% fell in Erin and 13% as a result of Opal. Results are presented for 17 species which had a sample size greater than 14 trees in each hurricane. All except one species--Chinese tallow or popcorn tree (*Sapium sebiferum*)--were native to Florida.

Of the conifer species affected by both hurricanes, sand pine (*Pinus clausa*) exhibited poor wind resistance with only 61% and 58% standing after these two hurricanes, see **Figures 2a , 2b , 2c and 3 .**

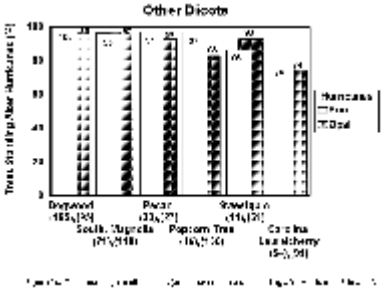


2a .

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.



2b .



2c .

Note: in Figures 2a-2c, numbers in parentheses denote the number of trees observed in Erin and Opal, respectively.

Of the conifer species affected by both hurricanes, slash (*Pinus elliottii* var. *elliottii*) and longleaf (*Pinus palustris*) pines survived the winds best **(Figure 2a)** .

Southern red cedar (*Juniperus silicicola*) was one of two species damaged inconsistently during the two hurricanes: 92% were still standing after Erin compared to 60% after Opal **(Figure 2a)** . Sabal palm (*Sabal palmetto*) was one of the most wind resistant species with 97% and 100% standing after the hurricanes; actually, the one sabal palm that was recorded as fallen was knocked over by another falling tree **(Figure 2a)** .

Of the oaks and maples, sand live oak (*Quercus geminata*), live oak (*Quercus virginiana*) and silver maple (*Quercus saccharinum*) did the best with laurel oak (*Quercus laurifolia)* , turkey oak (*Quercus laevis*) and red maple (*Acer rubrum*) comprising a less wind resistant group **(Figure 2b)** . Of the other dicot (broadleaf) trees, dogwood (*Cornus florida*), magnolia (*Magnolia grandiflora*) and pecan (*Carya illinoensis)* survived the hurricane best while Chinese tallow and sweetgum (*Liquidambar styraciflua*) comprised a second group and Carolina laurelcherry (*Prunus caroliniana*) held up poorly to the winds **(Figure 2c)** .

Five species were sampled in only one of the two hurricanes and so the results are preliminary for:

pignut hickory (*Carya glabra*), 100%;

pindo palm (*Butia capitata*), 97%;

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

sweet bay (*Magnolia virginiana*), 97%;

sycamore (*Platanus occidentalis*), 92%; and

loblolly pine (*Pinus taeda*)--82% still standing after one of the hurricanes.

Results from Other Hurricanes. After Hurricane Camille (1969) forestland trees were ranked for their wind resistance and live oak was at the top of the list *(6, 7)* . Live oak also did well in our study and after Hurricane Andrew *(2)* . Sabal palm was the second most wind-resistant tree in Hurricane Camille and the only tree that was "immune to hurricane-force winds" of Hugo in 1989 *(3, 6, 7)* . Both live oak and sabal palm survived the 145 mph winds of Andrew and then did well in this study after Erin and Opal *(2)* . Pecan was reported as the least wind-resistant tree species during Hurricane Camille *(6,7)* , yet in this study it survived the winds well. Three possible explanations for this different ranking could be:

1) Pecan is more exposed in orchards compared to neighborhoods; 2) Pecan does not tolerate winds greater than Erin and Opal; or 3) Our sample was too small (60 trees). Homeowners should be aware that pecan in urban settings may not be tolerant to stronger winds.

In forests during Camille *(6,7)* , dogwood was reported to be more easily uprooted, yet in our study in neighborhoods 100% and 96% of the dogwoods were still standing.

Southern Pines:

Over the years, hurricanes such as Camille, Frederick, Hugo and Andrew have helped people observe effects of hurricane-force winds on southern pines in forests and urban areas. Pines have most often been placed relatively low on hurricane-resistance lists due to their propensity for stem breakage *(1, 2, 6, 7)* . Hurricane damage to pine trees can also initiate outbreaks of pests such as bark beetles, ambrosia beetles, sawyers, and blue stain fungi that preferentially attack stem-damaged pines. ***Example:*** After Hurricane Andrew in 1992, many individual pines did not show immediate damage but died during the following year.

Therefore, even though high percentages of slash and longleaf pines were standing after Hurricanes Erin and Opal, their ability to survive hurricane level stresses may be less than other species with the same percentage of trees still standing.

How Did Trees Fall?

When trees fell, they were either uprooted or broken at the trunk **(Table 1).** Uprooting was the most common type of failure for slash and sand pines --while longleaf pine exhibited both kinds of damage-- and southern red cedar most often broke off at the main stem. Laurel oak was uprooted as compared to Chinese tallow which has a weak stem that snapped in two in the strong winds.

Crown Damage

Some species, still standing after the hurricanes, exhibited crown damage. Crown damage was defined as greater than 50% of the branches in the crown broken. Southern pines, oaks, palms, and dogwood all had little crown damage (less than 2% of the trees). Magnolia, pecan, red maple and Chinese tallow were in the next group with some damage (less than 10%) in one of the hurricanes **(Table 2).**

The most crown damage appeared on Southern red cedar, sycamore, silver maple, and sweetgum. South-

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

ern red cedar, sycamore, red maple and pecan were also considered susceptible to breakage in forests after Hurricane Camille. Although sweetgum was considered resistant in Hurricane Camille *(6,7)* , in our study sweetgum suffered the highest crown damage of all species in hurricanes Erin and Opal (20% of the trees).

Property Damage

Twenty-one percent and 8% of the fallen trees damaged property in Erin and Opal. (Of all the trees surveyed, just 2% and 1% damaged property.) Homes accounted for 67% and 29% of the damage in each of the hurricanes; the rest was damage to minor structures such as signs, fences and sidewalks.

In the study made after Hurricane Andrew, only 18% of the fallen trees damaged property and of the total trees in the survey only 7% damaged property *(2)* .

As would be expected, species that grow into large trees were more likely to cause property damage than small trees. Sand, slash, and longleaf pines and laurel oaks were more likely to cause damage *if they fell* than the smaller Southern red cedar, Carolina laurelcherry and Chinese tallow (**Table 3**).

Conclusions

Wind-Resistant Species

Using survey data we ranked tree species according to their wind resistance (**Table 4**).

As expected, some species appear to be better-suited for use in hurricane-prone areas than others. Dogwood, sand live oak, live oak, sabal palm, and Southern magnolia are native trees that appear to tolerate hurricane-force winds extremely well.

Less wind-resistant are laurel oak, turkey oak, Chinese tallow, and red maple. Southern red cedar, sweetgum and silver maple all appear to have crowns which are easily damaged by the winds.

Longleaf and slash pines, although standing up to the winds, receive their lesser wind-resistant rating because of their predisposition to insects and disease after experiencing hurricane-force winds.

Carolina laurelcherry and sand pine are the least wind-resistant species. Because of Carolina laurelcherry's smaller stature, it is less of a threat to property than sand pine. Sand pine should *not* be planted or allowed to grow to a large size near any dwelling; its shallow root system appears to make it extremely vulnerable to wind.

Need for More Information

For several reasons our wind-resistant lists are preliminary and need more observation and study.

First, several commonly planted species--such as loblolly pine, sycamore, and sweet bay--have been under-studied and cannot be placed on the appropriate list until we have more data on them.

For other species--such as water oak (*Quercus nigra*)--we had too small a sample to report, yet observations after Hugo reported that they were "all too aware of this tree's failure to survive the storm in an urban environment" *(4)* . We also have very little information on bald cypress (*Taxodium distichum*)

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

and pond cypress (*Taxodium distichum* var. *nutans*) although they are reported to be extremely wind-resistant *(5, 6, 7)* . We need more information on these species to continue to upgrade the lists.

Second, the winds of Hurricanes Erin and Opal (with 85 and 125 mph sustained winds) were not as strong as Hurricanes Camille, Frederick, Hugo and Andrew (all greater than 135 mph). In Andrew, for example, 38% of the trees died as compared to Erin and Opal with losses of 11 and 13%. Also, in Andrew almost every tree had crown damage compared to relatively little crown damage from Erin and Opal. In Charleston, Hugo destroyed up to 45% of all landscape trees *(3)* . It is because of the preliminary nature of these results, we urge you to use these lists as a starting point for forming a list based on your observations.

Cultural Practices

Site conditions in urban areas may often hinder good tree growth and tree health. All too often trees are planted where they have little rooting space or the soil is compacted. In contrast, adequate soil depth, lack of soil compaction, a deep water table, and adequate rooting space improve root system development and anchorage which contribute to wind firmness.

Also, maintaining healthy trees is critical to reducing damage in hurricanes. Our Hurricane Andrew study data showed that pruning can improve wind resistance and reduce tree failure *(2)* . However, pruning does not include the practice of topping which misshapes and destroys branching structure, nor does it include excessive crown thinning.

To create and maintain healthy urban forests, sound cultural practices should be observed in tree selection, location and maintenance--while property owners and communities should seek advice from certified arborists and remove hazard trees immediately.

Education

It is common after a hurricane for urban citizens to decide that trees are a problem and are undesirable in urban areas due to their damage potential. In this study we found only 1 to 2 % of the trees studied caused damage to property. While damage is undesirable at any level, impact on property can be balanced against the many other benefits of urban trees including energy conservation, reduction of storm-water runoff, wildlife habitat and beauty.

In addition to proper species selection, programs to teach urban citizens more about proper tree care, selection and maintenance can contribute to an urban forest with greater tolerance to hurricanes and storms.

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6. Swain, K.M. 1979. Minimizing timber damage from hurricanes. *S. Lumberman* 239:107-109.

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

7. Touliatos, P. and E. Roth. 1971. Hurricanes and trees: Ten lessons from Camille . *J. For* . 285-289.

Tables

Table 1.

Table 1. Failure type associated with fallen trees. *(Numbers in parentheses denote the number of fallen trees in Erin and Opal com-*		
Tree Species	% Broken	% Uprooted
Carolina Cherry (33)	51	49
Chinese tallow	81	19
Laurel oak (59)	36	64
Longleaf pine	50	50
Sand pine	22	78
Slash pine (44)	34	66
Southern red	63	37

Table 2.

Table 2. Tree species with Crown Damage > 5% after either 1995 panhandle Hurricane.		
Tree Species	% after Erin	% after Opal
Chinese tallow	0	7
Magnolia	6	0
Pecan	6	0
Red maple	0	9
Southern red cedar	8	10
Sycamore		15
Silver maple	7	19
Sweetgum	20	19

Table 3.

Table 3. Percentage of fallen trees (large-size species v. small-size species) causing property damage. *(Numbers in parentheses denote combined felled trees in Erin and Opal combined.)*	
Large Species	**% damaging property**
Laurel oak (59)	17
Longleaf pine (32)	18
Sand pine (263)	11
Slash pine (44)	17
Small Species	**% damaging property**
Carolina Laurel-	2
Chinese tallow (27)	4
Southern Red Cedar	4

Table 4.

Source: University of Florida Institute of Food and Agricultural Services, *"Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

Table 4. Wind resistance of tree species growing in the Florida Panhandle as determined by frequency of failure in Hurricanes Erin and Opal and other rankings from Hurricanes Camille and Andrew *(2, 6, 7)*.	
Most Wind-Resistant:	Dogwood
	Live oak
	Sabal palm
	Sand live oak
	Southern magnolia
Less Wind-Resistant:	Chinese tallow (popcorn tree)[1]
	Laurel oak
	Longleaf pine[2]
	Pecan[3]
	Red maple
	Silver maple[4]
	Slash pine[2]
	Southern red cedar[4]
	Sweetgum[5]
	Turkey oak
The worst:	Carolina laurelcherry
	Sand pine
Still a Question?[6]	Loblolly pine (82%)
	Pignut hickory (100%)
	Pindo palm (97%)[1]
	Sweet bay (97%)
	Sycamore (92%)[4]
[1] An exotic species	
[2] Pest problems after storms lower these rankings	
[3] Low ranking due to previous hurricanes low ranking	
[4] Weak crown	
[5] Very weak crown	
[6] Not enough urban data	

Footnotes
1. This document is Circular 1183, one of a series of the School of Forest resources and Conservation, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published: May, 1997. Reviewed September 2006. Please visit the EDIS Web site at http://edis.ifas.ufl.edu.
2. Mary L. Duryea, Ph.D., forest resource extension specialist, School of Forest Resources and Conservation, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.

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U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Larry Arrington, Dean.

Source: University of Florida Institute of Food and Agricultural Services, "*Wind and Trees: Surveys of Tree Damage in the Florida Panhandle after Hurricane Erin and Opal"* Retrieved July 16, 2007 from: http://edis.ifas.ufl.edu/.

Appendix E

Storm Water Pollution Prevention Plan for "Construction Activites"

Terrebonne Parish Consolidated Government

STORM WATER

POLLUTION PREVENTION PLAN

FOR

"CONSTRUCTION ACTIVITES"

Prepared For:

Terrebonne Parish Consolidated Government

Project Name: _____

Generic Plan Prepared By:

T. Baker Smith & Son, Inc.

Environmental Services Division

Houma, Louisiana 70361

Evans-Graves Engineers, Inc.

Engineering Consultants

Metairie, Louisiana 70001

Revised: June, 2003

Table of Contents

Table of Contents

Attachments

1.0 INTRODUCTION

This generic Storm Water Pollution Prevention Plan (SWPPP) has been prepared in accordance with the requirements of the Louisiana Pollutant Discharge Elimination System (LPDES) Storm Water General Permit for Construction Activities (Permit No. LAR100000).

TPCG will maintain a copy of this generic document for Consultants and Contractors to utilize for preparation of SWPPPs concerning parish projects. This generic document is to be completed prior to initiating construction activities and updated as appropriate; and the plan shall provide for compliance with the terms and schedule of the SWPPP beginning with the initiation of construction activities. Completed project SWPPPs will be maintained by TPCG.

The project SWPPP shall be amended, as appropriate, whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the discharge of pollutants to the waters of the State and which has not otherwise been addressed in the SWPPP.

The project SWPPP will also be modified and amended if a determination is made that this plan has proven to be ineffective in eliminating or significantly minimizing pollutants from sources identified herein, or is otherwise not achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity.

The permittee shall retain copies of all project SWPPPs, all reports required by the permit, and records of all data used to complete the Notice of Intent (NOI) for a period of at least three (3) years from the date that the site is finally stabilized. This period may be extended by request of the Agency (LDEQ) at any time.

A copy of the project SWPPP will be retained at the construction site from the date of project initiation to the date of final stabilization.

According to Permit No. LAR100000, Part IV.B.2, the permittee shall post a notice near the main entrance of the construction site with the following information:

1. the LPDES permit number (include the LPDES permit number assigned by LDEQ for the project or a copy of the NOI if a permit number has not yet been assigned);
2. the name and telephone number of a local contact person;
3. a brief description of the project; and
4. the location of the SWPPP if the site is inactive or does not have an on-site location to store the plan.

The permittees with day to day operational control over pollution prevention plan implementation shall have a copy of the plan available at a central location on-site for the use of all operators and those identified as having responsibilities under the plan whenever they are on the construction site.

1.1 Construction Activities (5 acres or more)

Construction activities, including clearing, grading, and excavating, that result in land disturbance of 5 acres or more are subject to the LPDES Storm Water General Permit for Construction Activities (Permit No. LAR100000). Construction activity also includes the disturbance of less than 5 acres of total land area that is a part of a larger common plan of development or sale if the larger common plan will ultimately disturb 5 acres or more.

TPCG will submit a LPDES Notice of Intent (NOI) to obtain authorization for each regulated project. Note: NOIs should be submitted at least 48 hours prior to commencing with soil disturbing activities.

Upon final stabilization of the entire construction site, the permittee will submit a Notice of Termination (NOT) in accordance with Part I.C and Part VIII of this permit to terminate the general permit coverage of storm water discharges.

Attachment No. 9 contains a copy of Permit No. LAR100000, LPDES Notice of Intent (NOI) and Notice of Termination (NOT) forms.

Note: Revised notices (NOI and NOT) are available at the Louisiana Department of Environmental Quality website (http://www.deq.state.la.us/permits/lpdes/index.htm).

1.2 Small Construction Activities (equal to or greater than 1 acre and less than 5 acres)

Construction activities, including clearing, grading, and excavating, that result in land disturbance of equal to or greater than 1 acre and less than 5 acres are subject to the LPDES Storm Water General Permit for Small Construction Activities (Permit No. LAR200000). Small construction activity includes the disturbance of less than 1 acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb equal to or greater than 1 acre and less than 5 acres. Small construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility.

Construction activities that result in a land disturbance of less than 1 acre may be regulated

under this permit if designated by the state administrative authority (LDEQ) or the EPA regional administrator, based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the state.

1.3 Exclusions

According to the Louisiana Administrative Code (LAC) 33:IX.2315.2, discharges of dredged or fill material into waters of the state which are regulated under section 404 of the Clean Water Act (CWA) do not require LPDES permits.

NOTE: The full Storm Water General Permit for Small Construction Activities ordinance can be downloaded from the Terrebonne Parish Consolidated Government web site at: http://www.tpcg.org/engineering/index.asp#LPDES

1.0 RESPONSBILITIES & CERTIFICATIONS

2.1 Responsibilities

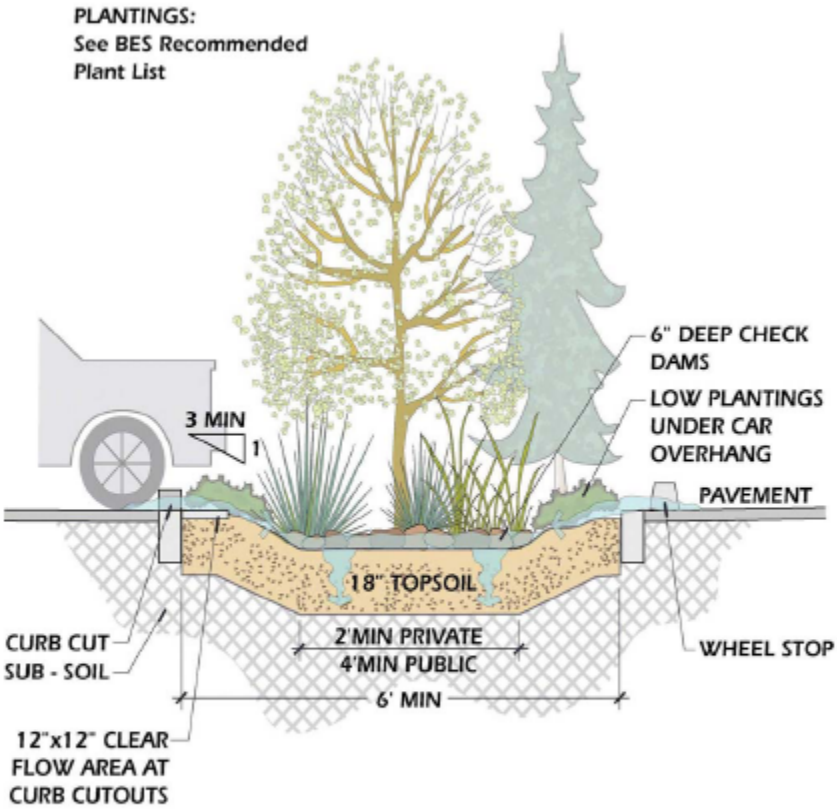
The following table depicts the management structure as it relates to storm water permitting:

Title	Members	Responsibilities
Principal Permittee / Operator	Terrebonne Parish Consolidated Government	Ensure SWPPP Implementation
		Submit a Notice of Intent (NOI) in accordance with the requirements of Permit No. LAR100000, Part II, at least 48 hours prior to the commencement of construction activities[1]
	Program Manager	Manage the SWPP Implementation
		Coordinate with the Consultant(s) and Contractor(s) to ensure that construction activities are performed in compliance with the SWPPP and the LPDES permit
Consultant(s)	Project Design Consultant(s)	Incorporate appropriate control measures (best management practices (BMPs) into projects to prevent pollution of storm water runoff.
		Identify additional BMPs if site conditions warrant.
		Prepare a project specific SWPPP as per this document.
Contractor(s)	Construction Contractor(s)	Comply with the provisions of the SWPPP
		Implement and maintain control lmeasures (BMPs) to prevent pollution of storm water runoff.
		Identify and implement additional BMPs if site conditions warrant.
Co-Permittee / Contractor	Construction Contractor(s)	File a separate Notice of Intent (NOI), identifying the Contractor as a co-permittee, at least 48hours prior to starting construction.1
Note: Permit No. LAR100000. Part's I.B.1.c, I.B.2, and II.A.1-4 describes Notification Rquirements related to Notice of Intent (NOI) submittal.		

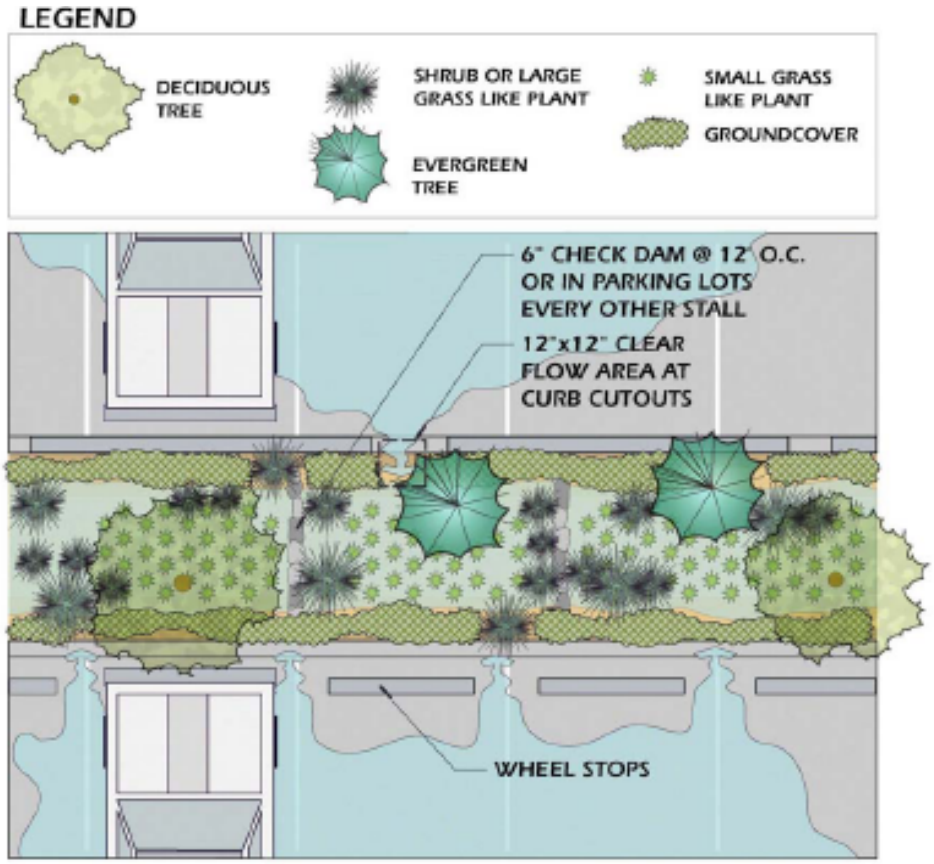
Appendix F

2004 Stormwater Management Manual Appendix G Supplemental Drawings and Example Landscape Plans

City of Portland



Vegetated Swale Parking Lot Application

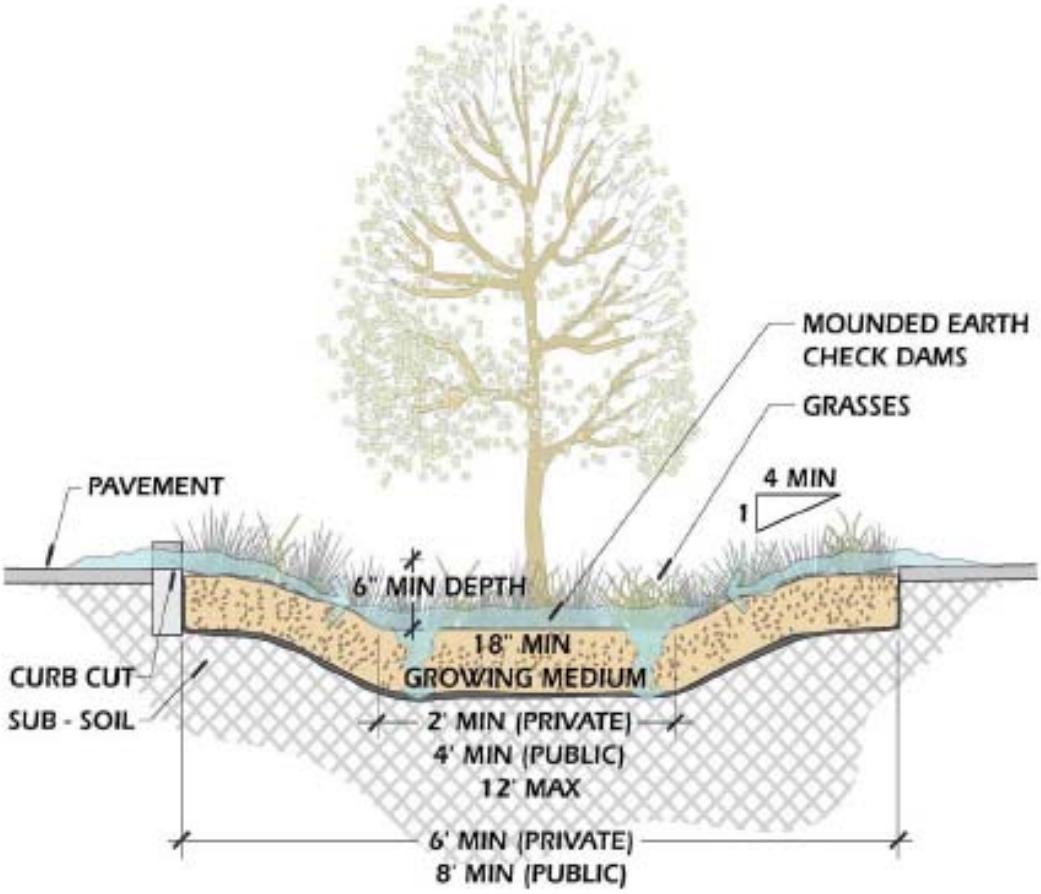


Swale Area = Approx. 400 sq. ft.
(Not to Scale)

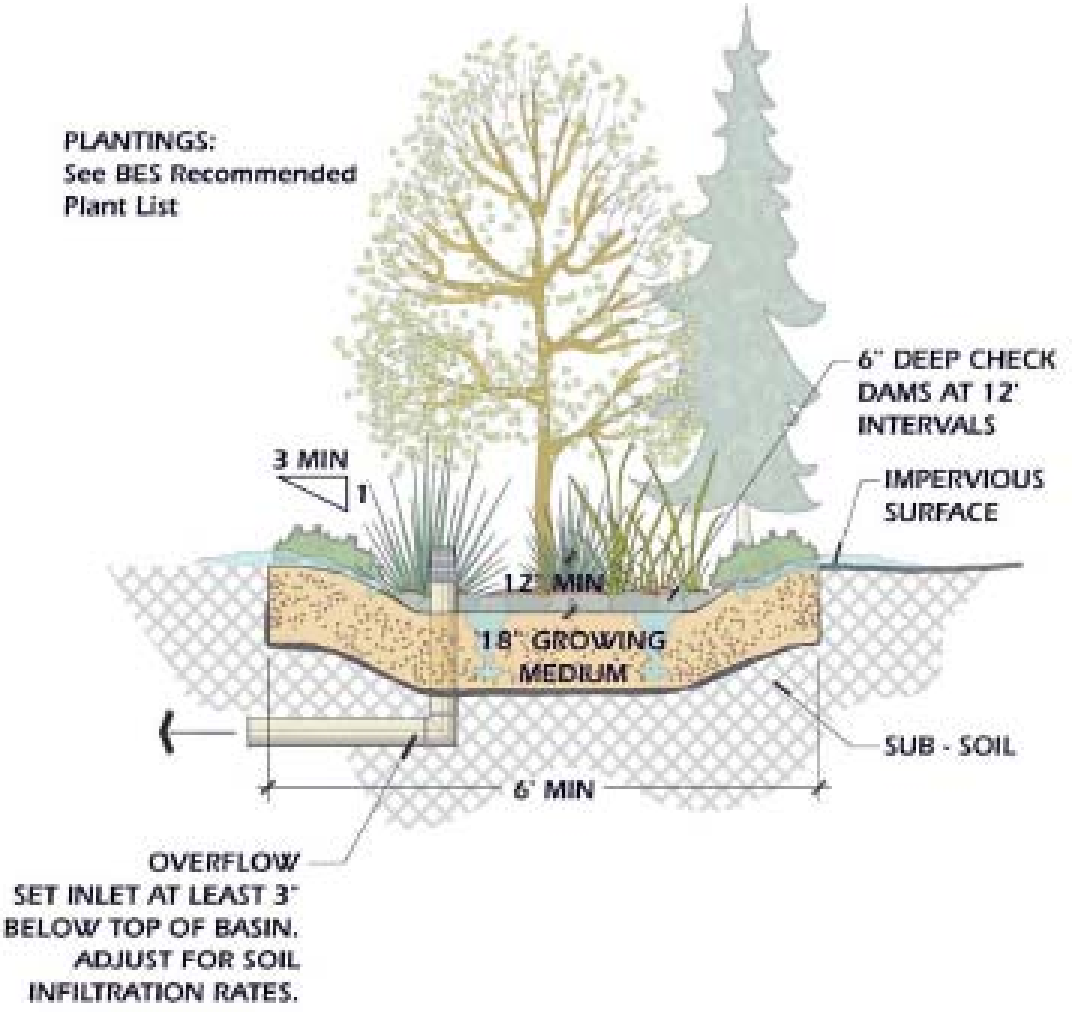
Notes:

1. At least 50% of the facility shall be planted with grasses or grass-like plants, primarily in the flow path.
2. Large grass like plants can be considered as shrubs.
   See BES recommended plant list and parking lot tree list and plant quantity requirements.

Vegetated Swale - Plan Parking Lot Application



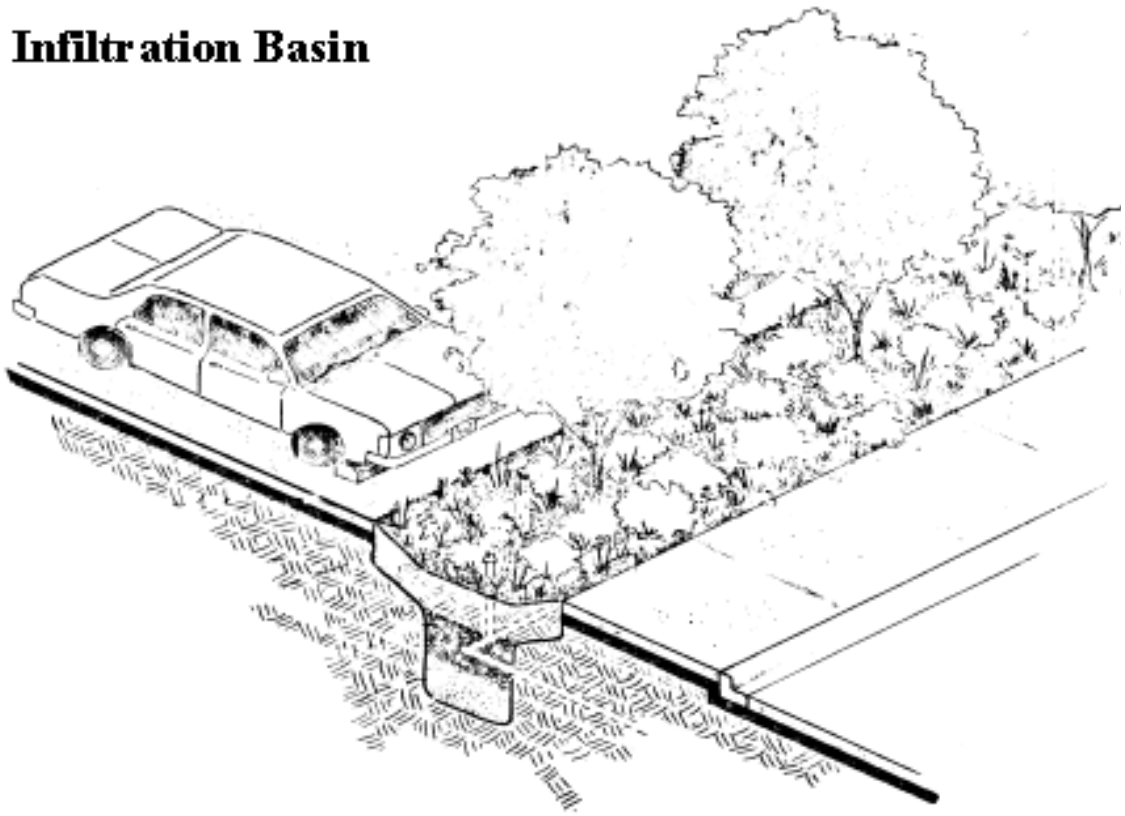
Grassy Swale



Vegetated Infiltration Basin

Portland Stormwater Management Manual

Vegetated Infiltration Basin



Wet and Extended Wet Ponds

The plan below illustrates a typical planting plan for an approximately 3,500 square foot wet or extended wet pond. This plan is diagrammatic use only. The actual project site condition may require designers to consider numerous other pond configurations and planting layouts.